Whether the factors of relative advantage, compatibility and complexity influence care providers' willingness to adopt shared electronic health records

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ABSTRACT

Based on an adaptation of Rogers' Diffusion of Innovation theory, this dissertation addresses the following research question - *Whether the factors of relative advantage, compatibility and complexity influence care providers' willingness to adopt shared electronic health records (SEHRs).*

Secondary data was collated through an extensive literature review of the legislative and regulatory environment related to health records and the emergence of shared electronic health records. Data was then collected through a self administered questionnaire distributed to over 5000 active members of the Australian Medical Association Queensland (AMAQ).

Data analysis initially comprised the use of Categorical Principal Component Analysis (CATPCA) to refine the variables related to Relative advantage, Compatibility and Complexity. Multiple regression analysis was then conducted to test the relationship between the dimensions of these three independent variables and the dependant variable future willingness to adopt SEHRs. Thirdly Chi-Square analysis was conducted to test whether future willingness to adopt SEHRs varied across the three tiers of the health sector or between public and private sector health care providers.

The data revealed that while 72% of those surveyed were willing to adopt SEHRs, significant differences existed between public and private sector care providers and across the three tiers of the health system (GP's, Specialists and Hospital Staff). In relation to the factors influencing future willingness to adopt SEHR's, the variables comprising Relative advantage were shown to have a significant impact upon future willingness to adopt SEHRs (significance levels <.001). An examination of the two dimensions of Relative advantage i.e. perceptions of benefits of technology in general and perceptions of potential advantages of SEHRs found that perceptions of the benefits of technology in general had the greatest potential influence on care providers' willingness to adopt. The variables comprising Compatibility were also shown to have a significant impact upon future willingness to adopt SEHRs (significance levels <.001). A comparison of the two dimensions comprising Compatibility i.e. perceived potential to improve communication between care providers' and perceived compatibility of SEHRs with care providers' values relating to patient care found that the variables best explained as the perceived compatibility of SEHRs with care providers values relating to patient care had the most significant potential to influence care providers willingness to adopt SEHRs. Finally, a significant relationship was also found to exist between the variables comprising Complexity and care providers' willingness to adopt SEHRs (significance level .037). When comparing the dimensions of Complexity i.e. perceived complexity related to information and records management and perceived complexity relating to compliance issues existed, only the variables best explained as perceived complexity relating to compliance proved to have any statistically significant influence on care providers' future willingness to adopt SEHRs.

The findings from this dissertation will benefit those responsible for the future introduction of SEHRs, specifically by allowing policy makers to target the factors that influence care providers' willingness to adopt. The use of perceptions of both currently experienced advantages/disadvantages of technology and perceptions of advantages/disadvantages of future adoption of technology and specifically SEHR's will also assist in revealing barriers to successful implementation of shared electronic health records.

This study also paves the way for future research to be conducted utilising a much larger sample tailored specifically to the Personally Controlled Electronic Health Record (PCEHR) system to be introduced in Australia from July 2012.

CERTIFICATE OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original, and has not been previously submitted for any other award, except where otherwise acknowledged.

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Signature of Candidate	Date

ENDORSEMENT

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Signature of Supervisor	Date

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 2

CHAPTER 4

CHAPTER 5

CHAPTER 6

LIST OF FIGURES

CHAPTER 1

CHAPTER 3

CHAPTER 4

CHAPTER 6

CHAPTER 1 – INTRODUCTION

1.1 Background to the Research

The use of technology is essential in providing the most accurate, up to date information to any care provider in the health sector in any situation, whether as a result of a routine check-up at the General Practitioner's office, or a complicated medical procedure in the operating room. There has been much written about the benefits of technology in facilitating a reduction in the number of medical errors currently being experienced worldwide. However, the relationship between perceptions of relative advantage, compatibility with existing systems and practices, and difficulties associated with complexity has not been widely addressed. The literature suggests that these factors may be impacting upon care providers' willingness to adopt shared electronic health records (SEHRs).

This paper investigates three key factors which may impact upon willingness to adopt i.e. care providers' perceptions of relative advantage, care providers' perceptions of compatibility with existing values, systems and practices, and care providers' concerns about complexity. The study employs an adaptation of Rogers' (1995) Diffusion of Innovation (DOI) theory. Roger's concept of rate of adoption is adapted in this study to willingness to adopt because in the case of SEHRs, adoption is likely to be mandatory as opposed to voluntary. Factors associated with mandatory adoption will vary slightly to those factors comprising voluntary adoption. The study aims to determine the factors likely to have the greatest influence upon care providers' willingness to adopt SEHRs.

The research deals with the adoption of SEHRs principally from the perspective of the care provider. Based upon Diffusion of Innovation theory (Rogers 1995), the aim of the research will be to identify how the many facets of SEHRs (relative advantage, compatibility, and complexity) have impacted upon care providers' future willingness to adopt.

Systems that manage information (information management/recordkeeping systems) in any industry are increasingly regarded as critically important in controlling and managing a complex range of information in order to comply with an expanding range of legislation and business needs. This is particularly relevant within the health sector. Lack of effective recordkeeping systems in the health sector costs a significant number of lives every year. Effective systems can provide access to the right information at the right time to aid in the decision making process for clinicians and also for patients in order to reduce this tragic loss of life. Despite the benefits of SEHRs, their widespread implementation has been extremely slow to date. Being able to identify factors which may explain the slow uptake of SEHRs could be considered highly desirable, both within and beyond the concept of SEHRs. By targeting those factors which may influence willingness to adopt, the adoption process could become a more efficient process targeted to address the concerns of the adopters.

1.2 Research Objectives and Hypotheses

An overview of literature relevant to the adoption of SEHRs such as Diffusion of Innovation, technology in health care, and regulatory requirements in the health sector has led to the development of a number of objectives and hypotheses.

Objectives which will be used to guide the study are:

- Use Diffusion of Innovation as developed by Rogers (1995) as the theoretical background for the research;
- Discuss rate of adoption of SEHRs as a component of Diffusion of Innovation theory and provide a rationale for focusing on the three factors of relative

- Analyse care providers' willingness to adopt SEHRs based on the factors identified in Diffusion of Innovation theory;
- Identify any additional factors not discussed within diffusion of innovation theory, which may influence willingness to adopt SEHRs;
- Identify whether care providers' perceptions of relative advantage influence their willingness to adopt SEHRs;
- Identify whether care providers' perceptions of compatibility with current systems and practices influence their willingness to adopt SEHRs;
- Identify whether care providers' perceptions of the complexity associated with SEHRs influence their willingness to adopt SEHRs;
- Identify any differences in willingness to adopt SEHRs by care providers across the tiers and sectors of care providers within Queensland.

The study aims to determine the factors likely to have the greatest influence upon care providers' willingness to adopt SEHRs. This thesis will address the overriding research question of: *Whether the factors of relative advantage, compatibility and complexity influence care providers' willingness to adopt shared electronic health records.*

This overriding research question is then subdivided into a number of hypotheses as follows:

H_1: *That perceptions of the variables comprising relative advantage have the potential to influence willingness to adopt shared electronic health records;*

H_2: *That perceptions of the variables comprising compatibility with existing systems and practices have the potential to influence willingness to adopt shared electronic health records;*

H_3: That perceptions of the variables comprising complexity have the potential to influence willingness to adopt shared electronic health records;

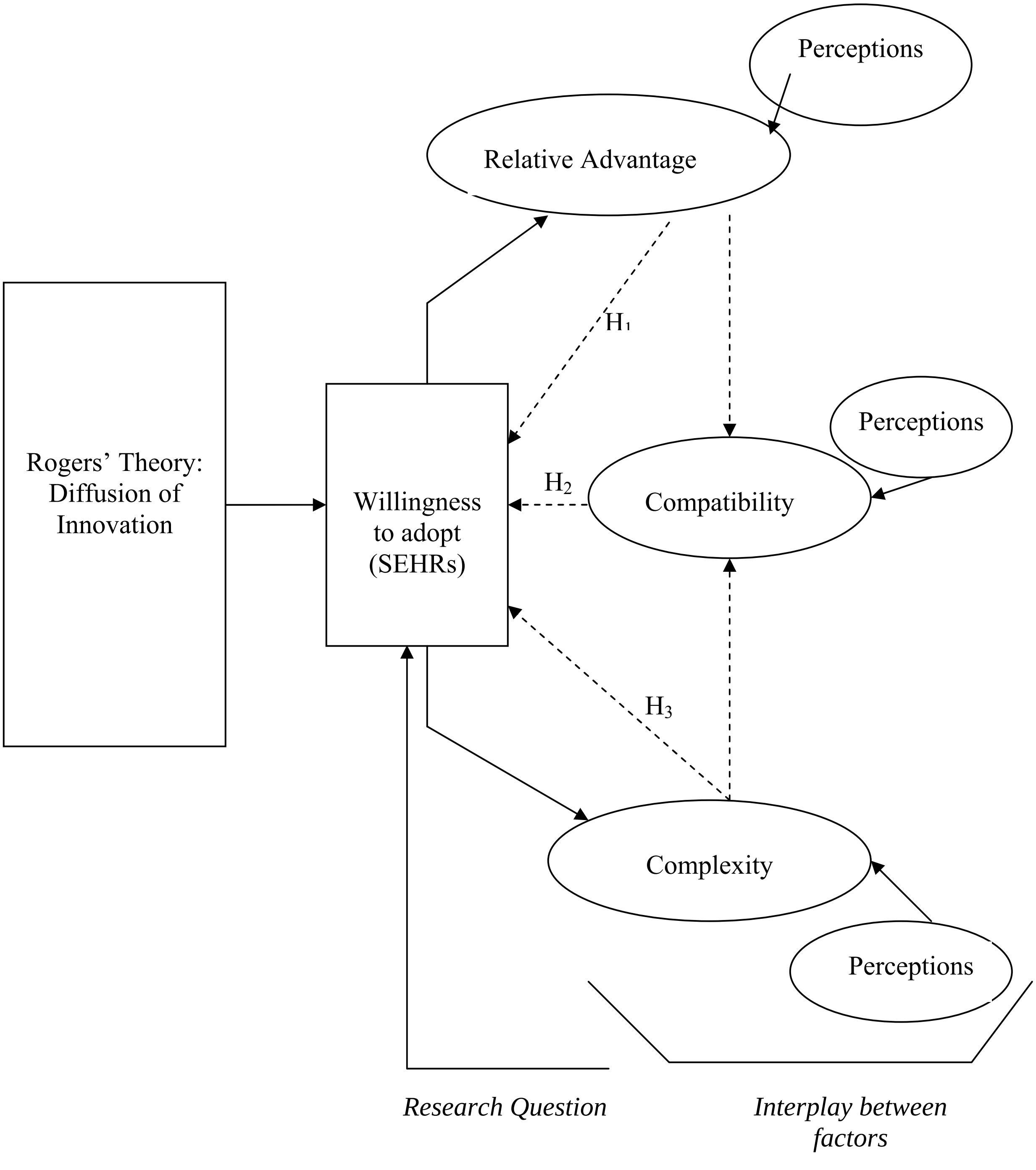
H_4: That willingness to adopt shared electronic health records varies across the three tiers of the health system within Queensland;

H_5: That willingness to adopt shared electronic health records varies across public and private sector health facilities within Queensland.

The following research model (Figure 1.1) illustrates the link between Rogers' diffusion of innovation theory and the research question investigated in the current study:

Figure 1.1 Model of Research

Whether the factors of relative advantage, compatibility and complexity influence care providers' willingness to adopt shared electronic health records.



1.3 Justification for the Research

The study makes theoretical and applied contributions by identifying potential approaches to improving willingness to adopt SEHRs amongst care providers.

Information has been obtained from a wide variety of care providers, within different care provider environments throughout Queensland. The study identifies whether perceived relative advantage, perceived compatibility, and/or perceived complexity have influenced care providers' willingness to adopt SEHRs. Determining the factors which have the greatest potential for influencing willingness to adopt innovation, - the innovation of SEHRs in the case of this study - can be considered highly desirable. This is validated by the Royal Australian College of General Practitioners (2004), who state that finding ways to promote the rapid adoption of information technology to improve information management is seen by many as the single most important step towards implementing electronic health systems. The identification of the factors likely to impact upon willingness to adopt could have significant potential for policy makers, both within and beyond the concept of SEHRs. Research suggests that surveys of care providers can provide important policy-relevant data and information that is often not captured by administrative data or registration databases (Aitken et al. 2008; Barklay et al. 2002; Grava-Gubins & Scott 2008; Scott et al. 2011).

This study contributes to the literature by not only identifying whether perceived relative advantage, perceived compatibility and perceived complexity influence care providers' willingness to adopt SEHRs, but also by identifying the specific variables comprising each of these factors with the greatest potential to influence care providers' willingness to adopt. By targeting those factors which may influence willingness to adopt SEHRs, the adoption process may become more efficient and more acceptable to adopters.

In addition, the study provides a good starting point for future research. This could include longitudinal studies, examining the effects and benefits of implementation of a SEHR system within a specific hospital, or in a more holistic approach, across a state or nation. Furthermore, future research could be conducted to compare the results of the current study later in the diffusion process, for example, after implementation has been mandated, to revisit the perceived costs and benefits of SEHRs to care providers. A number of sections of the questionnaire have been designed to allow gap analysis in relation to technology in health care to be conducted in future research study.

1.4 Methodology

Secondary data from journals, relevant texts, electronic and working paper sources concerning several topics including information management practices, diffusion of innovation theory, recordkeeping systems, and compliance with regulation and legislation within the health industry worldwide provide a conceptual and theoretical foundation for the study. An intensive literature review was conducted to gather evidence that would link willingness to adopt SEHRs with care providers' perceptions of relative advantage, compatibility, and complexity which overshadow the health industry. An analysis of the secondary data provided the means of establishing the research question, objectives and hypotheses to be investigated.

To gain a deeper understanding of the issues involved and to explore the research questions fully, the research question was tested using primary data. The quantitative phase of the research involved a self administered questionnaire involving all active Australian Medical Association Queensland (AMAQ) registered health care providers from the public and private sector. Roles of health care providers range from General Practitioners to Specialists. The goal of the questionnaire was to identify from a care providers' perspective, factors which have the most significant impact upon willingness to adopt SEHRs. The questionnaire was based on a number of factors comprising Rogers' Diffusion of Innovation theory relevant to SEHRs, specifically (a) relative advantage, (b) compatibility, and (c) complexity. To validate the findings of the study, Davis' Technology Acceptance Model (TAM) was used to verify whether the factors comprising the TAM were consistent with Rogers' Diffusion of Innovation theory in influencing care providers' willingness to adopt SEHRs.

The questionnaire was sent to currently active health care providers registered with the AMAQ. This population consisted of approximately 5013 care providers, located throughout Queensland. A total of 588 valid responses were received. The questionnaire identified whether perceived relative advantage, perceived compatibility, and/or perceived complexity have impacted care providers' willingness to adopt SEHRs. This was achieved through the questionnaire examining (a) care providers' perceptions of the potential advantages of SEHRs, (b) how care providers' perceptions of compatibility influence use of technologies such as SEHRs and (c) how care providers' perceptions of the complexity associated with compliance and information/records management considerations impacted upon their willingness to adopt SEHRs.

Once collated, the information from the survey was analysed using the program Statistical Package for Social Sciences (SPSS). The link between the three primary independent variables (relative advantage, compatibility, complexity) and the dependent variable future willingness to adopt SEHRs was investigated through a number of research questions and hypothesis testing, using a variety of analysis techniques.

Testing of hypothesis one was undertaken in two stages. Categorical Principal Component Analysis (CATPCA) was initially used to identify the component structure of the variables comprising Relative advantage. Through the application of CATPCA, those variables that had the greatest influence on care providers' future willingness to adopt SEHRs were identified. This analysis also established that the variables comprising relative advantage fitted into two distinct dimensions – (a) perceived benefits of technology in general and (b) perceived advantages of SEHRs.

Once the variables with the greatest influence related to relative advantage were identified, multiple regression analysis was undertaken to test the statistical significance of the variables comprising Relative advantage. This analysis would identify whether the dimensions of Relative advantage i.e. perceived benefits of technology in general and the perceived advantages of SEHRs, had the potential to influence care providers' future willingness to adopt SEHRs.

Similarly to hypothesis one, testing of hypothesis two was undertaken in two stages. Categorical Principal Component Analysis was used to identify the component structure and most influential variables identified as comprising Compatibility as defined in the context of this study. Similarly to hypothesis one, this analysis identified two distinct dimensions – (a) perceived potential to improve communication between care providers' and (b) perceived compatibility of SEHRs with care providers' values relating to patient care.

The second stage of testing for hypothesis two was to apply multiple regression analysis to the two identified dimensions of Compatibility. This would identify whether perceptions of SEHR compatibility with care providers' values relating to patient care and the perceptions of potential to improve communication between care providers' had the potential to influence care providers' future willingness to adopt SEHRs.

The same testing format was used for hypothesis three as was used with the first two hypotheses. Categorical Principal Component Analysis was used to identify the component structure and most influential variables identified as comprising Complexity, as defined in the context of this study. Analysis found that Complexity consisted of two distinct dimensions – (a) perceptions of complexity relating to information and records management and (b) perceptions of complexity relating to compliance.

Multiple regression analysis was then used to test whether the two dimensions of Complexity i.e. perceptions of the complexity relating to compliance and the perceived complexity of information and records management considerations, had the potential to influence care providers willingness to adopt SEHRs.

Testing of hypotheses four and five involved significance testing through use of Chi-Square analysis to test for any statistically significant difference in results relating to willingness to adopt SEHRs between the levels of care providers' within Queensland (i.e. GPs, Specialists and Hospital staff), and between public and private sector health facilities within Queensland.

1.5 Outline of Thesis

The format of the thesis is as follows. Chapter One briefly overviews the background of the research, states the research problem and hypotheses, provides justification for the research, outlines definitions needed to understand concepts raised within the study and states any limitations which may be presented.

Chapter Two focuses on compliance. The chapter identifies factors such as the regulatory and legislative requirements impacting on care providers'. The relationship between difficulties associated with electronic health systems and the identified regulatory and legislative requirements are then developed.

Chapter Three takes an in depth look at the use of technology in health care. The background to the SEHR is established, including an examination of the need for the technology and an overview of Australian initiatives in the area. Arguments for and against electronic health systems are presented, and the link is then developed between Rogers' diffusion of innovation theory, Davis' Technology Acceptance Model and the adoption of SEHRs.

Chapter Four studies the research design and methodology employed for this study. The methodology examines aspects of the study such as primary and secondary data, the survey and questionnaire design used, the sampling process employed, the response rate for the survey, validity and reliability issues and data analysis techniques employed. In addition, this chapter outlines the theory used to formulate the research model for this study. Rogers' diffusion of innovation theory and Davis' Technology Acceptance Model are outlined in detail, and the link between implementation of SEHRs and the theory is established.

Chapter Five provides an overview of the data prior to the analysis of the data and hypothesis testing conducted in Chapter Six.

Chapter Six provides a comprehensive analysis of the data obtained from the SEHR survey by testing the research hypotheses outlined in Section 1.4. Testing methods included CATPCA, multiple regression analysis and Chi-Square analysis.

Chapter Seven provides conclusions, tentative results, and suggestions for further research. This chapter also identified limitations encountered during the course of the study. These limitations include response error, questionnaire administration techniques and duration of the study.

1.7 Delimitations of Scope and Key Assumptions

This research contains one key assumption. This assumption is that the people involved in the questionnaire process had an awareness of the implications of implementation of SEHRs.

1.8 Summary

The use of technology is essential in providing the most accurate, up to date information to any care provider in the health sector in any situation, whether as a result of a routine check-up at the General Practitioner’s office, or a complicated medical procedure in the operating room. There has been much written about the benefits of technology in facilitating a reduction in the number of medical errors currently being experienced worldwide. However, the relationship between perceptions of relative advantage, compatibility with existing systems and practices, and difficulties associated with complexity has not been widely addressed. The literature suggests that these factors may be impacting upon willingness to adopt SEHRs.

This study details the research conducted regarding the perceived effects of relative advantage, compatibility and complexity from a care providers’ perspective upon willingness to adopt SEHRs. Rate of adoption, a component of Rogers’ theoretical framework relating to diffusion of innovation theory, was adapted to facilitate an investigation of *willingness* to adopt. Willingness to adopt was used because measuring rate of adoption would not be applicable because of eventual *mandatory* implementation of SEHRs. What was relevant was care providers’ future willingness to adopt SEHRs, and the factors which influenced their future willingness to adopt.

The study employed literature reviews in the areas of innovation theory, compliance and electronic health systems. The primary aim of the research was to examine the impact of Relative advantage, Compatibility and Complexity upon willingness to adopt shared electronic health records.

The study employed a self-administered questionnaire design, examining public and private sector care providers registered with the AMAQ. The data attained from the questionnaire was analysed using CATPCA, multiple regression analysis and other statistical techniques. Based on the dependent variable (future willingness to adopt

SEHRs), the data was analysed to determine whether three primary independent variables (Relative advantage, Compatibility, Complexity) have impacted upon the dependent variable, from the perspective of the care provider.

The research question for this study is:

Whether the factors of relative advantage, compatibility and complexity influence care providers' willingness to adopt shared electronic health records.

The hypotheses which were tested were:

H_1: *That perceptions of the variables comprising relative advantage have the potential to influence willingness to adopt shared electronic health records;*

H_2: *That perceptions of the variables comprising compatibility with existing systems and practices have the potential to influence willingness to adopt shared electronic health records;*

H_3: *That perceptions of the variables comprising complexity have the potential to influence willingness to adopt shared electronic health records;*

H_4: *That willingness to adopt shared electronic health records varies across the three tiers of the health system within Queensland;*

H_5: *That willingness to adopt shared electronic health records varies across public and private sector health facilities within Queensland.*

The study is envisaged to make an applied and theoretical contribution to the area of willingness to adopt SEHRs and other aspects of eHealth systems. The study has the potentially greatest contribution for policy makers, in that the thesis will identify those factors impacting upon individuals' *willingness to adopt* technology, and therefore highlight the factors which would have the greatest effect in overcoming potential reluctance to change. Given the current landscape in Australia with SEHRs and the impending implementation of a SEHR model in July 2012, this study may contain findings of specific relevance which indicate specific variables that influence care providers’ willingness to adopt.

The next chapter will present a detailed look at the legislative and regulatory environment which care providers’ and their organisations are required to comply with, and identify the implications relating to records kept, specifically electronic patient records.

CHAPTER 2 – COMPLIANCE

2.1 Legislative Requirements

Public hospitals, private hospitals, day procedure centres and community health centres have legal obligations to protect the confidentiality of patient information (Metropolitan Health 2003). Burke and Weill (2005) suggest that guaranteeing the accuracy and security, and protecting the privacy of medical records is crucial. This is because the potential for breaches of confidentiality may render patients less ready to share confidences with doctors (Keeley 2000). In order to help achieve privacy, many forms of legislation and regulation exist which health care organizations must adhere to. Laws that protect patient information have been written with two key principles in mind; (a) to protect the confidentiality of patients' health care information; and (b) to allow the gathering and use of important health care information to ensure that safe and effective treatment can be provided. The gathering and use of health care information is especially important where there is a public interest in its collection and use, such as information facilitating improvements to the health care system (Metropolitan Health 2003). There is a potential conflict of interest between these two principles, which creates complications and confusion over patient information requirements.

Lim (2001) states that 'health records and medical privacy is undoubtedly one of the most controversial, most complicated and at the same time most important of the privacy issues facing Australian society'. The Queensland Privacy Committee stated that 'information privacy is the area in which there is greatest public concern' (Legal Constitutional and Administrative Review Committee 1998, p. 15). The Commonwealth Department of Health and Ageing (2010a) states that privacy is a fundamental principle underpinning quality healthcare. Consumer trust in the appropriate handling of personal health information must be maintained as the health sector moves to adopt and implement new technologies. Ensuring that there is a clear privacy framework will allow consumers to reap the benefits from improved information flows at the point of care, knowing that their privacy will be protected.

2.2 Regulation

2.2.1 Quality in Health Care

Without a regulatory requirement covering information quality and information privacy, no one will take the first step in adopting shared electronic health records (SEHRs) (Detmer & Gillings 2000). This is especially true relating to the implementation of the Australian Personally Controlled Electronic Health Record (PCEHR) System. For the Australian Government to fulfil the objectives of improving the health system, it must demonstrate that every attempt has been made to achieve the appropriate balance between the competing objectives of multiple distributed access to health information and minimising any unnecessary and avoidable privacy intrusions (Commonwealth Department of Health and Ageing 2011c). Kohn (2000) asserts that regulation and legislation play a particularly important role in assuring a basic level of safety for everyone using the health system. In July 2011, the Commonwealth Department of Health and Ageing released their *PCEHR Legislation Issues Paper* (Commonwealth Department of Health and Ageing 2011b). This issues paper outlines the proposed legislative framework to support the establishment and implementation of a national personally controlled electronic health record (PCEHR) system. The paper describes the approach to establishing the system, explains how a PCEHR will benefit consumers and healthcare providers, and sets out the legislative framework and proposals for discussion.

Kohn (2000) states that regulation and legislative action can influence quality in health care organisations in two ways such as (a) empowering the chief executive officer to take action and improve internal quality, and (b) ensuring that all health care organisations make appropriate investments in systems for quality, thus creating a more level playing field throughout the industry. It should also be noted, however, that regulation and legislation can also create disincentives for quality, such as lax or conflicting standards (Kohn 2000). A reliable system for patient identification, coupled with comprehensive policies and/or legislative acts protecting privacy of individuals and security of personally identifiable information, is a necessary component of the electronic health record implementation process in many health care delivery systems around the world (Commonwealth Department of Health and Ageing 2011; Health Canada 1998).

2.3 Legislation

A large portion of the information captured within electronic health records for the patient is driven by regulations and standards (Watkins et al. 2009). The following list outlines a range of Legislation and Standards relating to the provision of health information. It should be noted that many other Acts apply to the health sector. However, those listed below relate specifically to health *information* needs, and demonstrate the increase in the volume of Standards and Legislation impacting upon the health sector's information needs over the past ten years.

Legislation impacting upon the health care sector, specifically relating to information needs (Queensland specific legislation outlined in more detail in Section 2.4):

1. *Personally Controlled Electronic Health Records Bill 2011;*
2. *Healthcare Identifiers Act 2010*;
3. *Commonwealth Privacy Act 1988*;
4. *Commonwealth Privacy Amendment (Private Sector) Act 2000*;
5. Section 95 Guidelines;
6. Section 95A Guidelines;
7. *Telecommunications Act 1997*;
8. *Health Records and Information Privacy Act 2002* (*NSW*);

9. Victorian Retention and Disposal Authority for Patient Information Records (PROS 11/06);
10. *Health Records Act 2001* (*Vic)*; and
11. Voluntary Codes.

(Australian Industry Group 2004; Caslon Analytics 2004; Melbourne Health 2004; Metropolitan Health 2003; Office of the Federal Privacy Commissioner 2002a; Parliament of the Commonwealth of Australia 2011; Queensland Government 2009a; Queensland Government 2009b; Sneddon & Noonan 2000; Standards Australia 2002).

2.3.1 Personally Controlled Electronic Health Records Bill 2011

The Personally Controlled Electronic Health Records Bill 2011 will establish the national personally controlled electronic health record (PCEHR) system and provide its regulatory framework, including an entity that will be responsible for the operation of the PCEHR system (Parliament of the Commonwealth of Australia 2011). The PCEHR Bill will also implement a privacy regime specific to the PCEHR system which will generally operate concurrently with Commonwealth, state and territory privacy laws.

The PCEHR Bill provides clear privacy protections and clarifies how state and territory privacy laws will apply. It prescribes the circumstances in which registered consumers and entities can collect, use and disclose information in consumers’ PCEHRs. The Bill also allows for a range of remedies, including civil penalties, where there is an unauthorised use, collection or disclosure of information in a consumer’s PCEHR or where certain actions occur that might compromise the integrity of the PCEHR system (Parliament of the Commonwealth of Australia 2011).

Key objectives of the PCEHR Bill include enabling the establishment and operation of a national system for the provision of access to health information relating to consumers of healthcare, to:

(a) help overcome the fragmentation of health information; and

(b) improve the availability and quality of health information; and

(c) reduce the occurrence of adverse medical events and the duplication of treatment; and

(d) improve the coordination and quality of healthcare provided to consumers by different healthcare providers.

(Personally Controlled Electronic Health Records Bill 2010)

2.3.2 Healthcare Identifiers Act 2010

Governments across Australia have committed to a national approach to e-health that will enable a safer, higher quality, more equitable and sustainable health system for all Australians. A healthcare identifier is a unique number that has been assigned to healthcare consumers, and to healthcare providers. A key aim of healthcare identifiers is to ensure that individuals and providers can have confidence that the right health information is associated with the right individual at the point of care (Commonwealth Department of Health and Ageing 2010a; *Healthcare Identifiers Act 2010*).

The purpose of the *Healthcare Identifiers Act 2010* is to provide a way of ensuring that an entity that provides, or an individual who receives, healthcare is correctly matched to health information that is created when healthcare is provided.

2.3.3 Commonwealth Privacy Act 1988

The National Privacy Principles (the NPPs) in the *Commonwealth Privacy Act 1988* set out how private sector organisations should collect, use, store, secure and disclose personal information. These principles set the minimum standards for privacy that organisations must meet. The NPPs give individuals a right to know what personal information an organisation holds about them and a right to access and correct that information if it is wrong. New Australian Privacy Principles (APP) are currently being drafted which will replace the Information Privacy Principles (which apply to Commonwealth agencies) and the National Privacy Principles (which apply to certain private sector organisations). It is proposed that the Australian Privacy Principles will regulate collection, holding, use and disclosure of personal information that is included in records or generally available publications (Ludwig 2010).

Under Queensland's *Information Privacy Act 2009,* Queensland Health is bound by a modified version of the NPPs found in the *Commonwealth Privacy Act 1988*. Queensland Health is not subject to Commonwealth privacy legislation. (Australian Industry Group 2004; Office of the Federal Privacy Commissioner 2001; Queensland Government 2009a; Queensland Health 2009). The NPPs within the *Information Privacy Act 2009* (for the most part) mirror the privacy principles with which private sector organisations are required to comply under the *Commonwealth Privacy Act 1988*. The National Privacy Principles of the *Information Privacy Act 2009* are expanded upon below.

The National Privacy Principles of the Information Privacy Act 2009:

2.3.3.1 NPP 1 Collection of personal information

These principles apply to the collection of health information. In general, they require a health service provider to: collect only the information necessary to deliver the health service; collect lawfully, fairly and not intrusively; and obtain a person's consent to collect health information about them. Providers also need to ensure that consumers are informed about why their health information is being collected, who is collecting it, how it will be used, to whom it may be given and that they can access it if they wish.

2.3.3.2 NPP 2 Limits on use or disclosure of personal information

This principle sets out how providers can use and disclose health information. 'Use' refers to the handling of information within an organisation. 'Disclosure' is the transfer of information to a third party outside the organisation. A health service provider may use or disclose health information:

- For the main reason it was collected (the primary purpose); or
- For directly-related secondary purposes, provided.
    - the consumer would reasonably expect these; or
    - the consumer gives consent to the proposed use or disclosure; or
    - if one of the other provisions under this principle applies.

The key is to make sure that there is alignment between the expectations of the health service provider and those of the consumer about what will be done with the health information.

2.3.3.3 NPP 3 Data Quality

Health service providers are required to take reasonable steps to ensure that the health information it collects, uses or discloses is accurate, complete and up to date.

2.3.3.4 NPP 4 Data Security

This principle requires that health service providers take reasonable steps to protect and secure health information from loss, misuse and unauthorised access. As health information may be needed for future care of the individual or for public health reasons, the priority should be to secure the data properly. Information that is no longer needed should be destroyed.

2.3.3.5 NPP 5 Openness

Health service providers need to be open about how they handle health information. A provider must develop a document for consumers which clearly explains how their organisation handles health information. The document must be made available to anyone who asks for it.

2.3.3.6 NPP 6 Access to documents containing personal information

Consumers have a general right of access to their own health records. Access can only be denied in certain circumstances - for instance where access can pose a serious risk to a person's life or health. Also, consumers can ask for information about them to be corrected if it is inaccurate, incomplete or out-of-date. The provider will need to take reasonable steps to correct the information.

2.3.3.7 NPP 7 Amendment of documents containing personal information

If the department has control of a document containing personal information, it must take all reasonable steps, including by the making of an appropriate amendment, to ensure the personal information:

(a) is accurate; and

(b) has regard to the purpose for which it was collected or is to be used and to any purpose directly related to fulfilling the purpose, is relevant, complete, up to date and not misleading.

2.3.3.8 NPP 8 Anonymity

Where lawful and practicable, consumers must be given the option to use health services without identifying themselves.

2.3.3.9 NPP 9 Sensitive information

The department must not collect sensitive information about an individual unless:

(a) the relevant individual has consented; or
(b) the collection is required by law; or
(c) the collection is necessary to prevent or lessen a serious threat to the life, health, safety or welfare of an individual, and the relevant individual;
  (i) is physically or legally incapable of giving consent to the collection; or
  (ii) physically can not communicate consent to the collection; or
(d) the collection is necessary for the establishment, exercise or defence of a legal or equitable claim; or
(e) the information is a family medical history, social medical history or other relevant information about any individual, that is collected for the purpose of providing any person, whether or not the relevant individual, with a health service, and is collected by the department.

(Queensland Government 2009a)

2.3.4 Commonwealth Privacy Amendment (Private Sector) Act 2000

The *Commonwealth Privacy Amendment (Private Sector) Act 2000* creates a single, nationally consistent framework for protecting privacy. The Act complements existing codes of practice and ethics in the health sector. The Privacy Act stipulates that providing a 'health service' includes any activity that involves:

- assessing, recording, maintaining or improving a person's health; or
- diagnosing or treating a person's illness or disability; or
- dispensing a prescription drug or medicinal preparation by a pharmacist.

The Privacy Act applies to all private sector organisations that deliver these types of services, including all small health services that hold health information (Office of the Federal Privacy Commissioner 2001). Details regarding Legislation specific to Queensland public sector organisations are dealt with in section 2.4. The Privacy Act contains eleven Information Privacy Principles (IPPs) which apply to Commonwealth and ACT government agencies. It also comprises the National Privacy Principles (NPPs) which apply to parts of the private sector and all health service providers (with the exception of Queensland as outlined previously).

2.3.5 Section 95 Guidelines

Section 95 of the *Privacy Act 1988* (Cth) provides a process which acknowledges that in some circumstances the right to privacy must be weighed against justifiable interests that may benefit society as a whole (Melbourne Health 2004).

2.3.6 Section 95A Guidelines

Section 95A Guidelines establish a process by which Human Research Ethics Committees may approve proposals that involve the collection, use or disclosure of health information held by private sector organizations without the consent from the individual concerned (Melbourne Health 2004).

2.3.7 Telecommunications Act 1997

A great deal of both individual and community health information is transmitted electronically through internet traffic and email networks, and via phone lines. Therefore, it is important that these networks are subject to standards which regulate a safe passage of communications.

The privacy of telecommunications is regulated by the *Telecommunications Act 1997 (Cth)*. The *Telecommunications Act 1997 (Cth)* regulates the carriage of communications between persons and persons, between things and things and between persons and things, in whatever form, by means of guided and/or unguided electromagnetic energy (Oz NetLaw 2001). The Act requires that compliance with industry standards, performance codes or schemes for the protection of customers are adhered to. Protecting the confidentiality of information routed through a network is of the highest priority to the Act. A use or disclosure of confidential information will not be an offence if made under lawful authorisation, in connection with the person's duties as a telecommunications contractor or other eligible person (Oz NetLaw 2001).

2.3.8 Health Records and Information Privacy Act 2002 (NSW)

The *Health Records and Information Privacy Act 2002* (NSW) governs the handling of health information in both the public and private sectors in New South Wales. This includes hospitals whether public or private, doctors, and other health care organisations. It also includes other organisations that have any type of health information. This can be as varied as a university that undertakes research, or a gymnasium that records information about a person's health and injuries (Privacy NSW 2004). This act commenced September 1, 2004.

2.3.9 Victorian Retention and Disposal Authority for Patient Information Records (PROS 11/06)

The General Disposal Schedule for Public Health Services Patient Records (PROS 11/06) was issued on 9 September 2011 under Section 12 of the Public Records Act 1973. It replaces the *PROS 99/04 General Retention & Disposal Authority for Public Health Services Patient Information Records*, issued on 19 May 1999 (Public Records Office Victoria, 2011). The Schedule defines the retention periods and consequent disposal actions authorised for patient information records held by Victorian public hospitals, extended care hospitals, and community health centres and mental health services. The Schedule (as with previous versions), aims to ensure that patient information is retained long enough to meet clinical and legal requirements, but balanced with the need for effective and efficient records management practices (Public Records Office Victoria, 2011; Department of Human Services 1999). Most patient records must be kept for a minimum of seven years. However, for most hospital admissions, the main patient record must be kept for a minimum of fifteen years and some types of documents such as registers of births within hospitals, must be permanently retained by health care services (Public Records Office Victoria 2011).

2.3.10 Health Records Act 2001

The *Health Records Act 2001* covers the handling of all personal information held by health service providers in the Victorian public and private sectors such as general practitioners, private specialists, dentists etc, as well as by all other private organisations which do not provide a health service but still collect health information such as insurance companies, sporting clubs and employers (Melbourne Health 2004; Metropolitan Health 2003).

2.3.11 Voluntary Codes

In addition to the above mandated legislation, there are a number of voluntary codes in addition to the above legislations which regulate the handling of personal information. These include:

- Royal Australian College of General Practitioners *Handbook For The Management Of Health Information In Private Medical Practice 2002*. This Handbook was published in November 2002. It was developed as a best practice model to assist medical practitioners in complying with their legal and ethical

- AS/NZS ISO/IEC 27001:2006 - *Information technology* - *Security techniques* - *Information security management systems* - *Requirements*. This international standard deals with the management of information security, and relies on assessing and managing risk to manage information and asset security. It specifies requirements for establishing, implementing and documenting information security management system and appropriate security controls (AS/NZS ISO/IEC 27001:2006).

2.4 Queensland State Legislation and Regulation

Previously, Standards relating to Victoria (e.g. the *Health Records Act 2001)* and New South Wales (*Health Records and Information Privacy Act 2002)* have been outlined. This section of the research outlines the legislative and regulatory environment specifically relating to Queensland care providers. Specifically, the *Information Privacy Act 2009, Right to Information Act 2009* and *Public Records Act 2002* is discussed. More detail is provided for Queensland due to notable differences in laws compared to New South Wales and Victoria. As previously identified, the laws in New South Wales and Victoria apply to both the private and public sector. The legislation which does exist in Queensland is directed towards the public sector and the Department of Health (Australian Industry Group 2004). Within Queensland, there is no specific legislation that covers the private sector. The Federal Privacy laws apply to the private sector as they do in every other state. Government departments are bound by the *Information Privacy Act 2009* and *Right to Information Act 2009* (Queensland Government 2009b).

2.4.1 Information Privacy Act 2009

From 1 July 2009, the *Information Privacy Act 2009* and *Right to Information Act 2009* replaced Information Standard 42 Information Privacy, Information Standard 42A Information Privacy for Queensland Department of Health and the *Freedom of Information Act 1992.* Through this updated legislation, the Queensland Government is committed to providing access to information held by the Government and by public authorities and agencies, unless on balance it is contrary to the public interest to provide that information.

The *Information Privacy Act 2009* recognises that it is 'often necessary to find a balance between the privacy interests of the person whose information is collected or handled and the legitimate interests of good government and other people' (Office of the Information Commissioner Northern Territory 2004; Queensland Government 2009a). The rules for protecting privacy are set out in eleven Information Privacy Principles (IPPs), which are briefly listed below:

- Principle 1 – Collection of personal information (lawful and fair);
- Principle 2 – Collection of personal information (requested from individual);
- Principle 3 – Collection of personal information (relevance etc.);
- Principle 4 – Storage and security of personal information;
- Principle 5 – Providing information about documents containing personal information;
- Principle 6 – Access to documents containing personal information;
- Principle 7 – Amendment of documents containing personal information;
- Principle 8 – Checking of accuracy etc. of personal information before use by agency;
- Principle 9 – Use of personal information only for relevant purposes;
- Principle 10 – Limits on use of personal information; and
- Principle 11 – Limits on disclosure.

Queensland Government 2009a

The principles of the *Information Privacy Act* 2009 are consistent with the previous Information Standard 42, which set out the privacy regime for all Government Departments (other than Queensland Health) and all statutory bodies including health portfolio statutory bodies (Queensland Government 2003b). The purpose of the *Information Privacy Act 2009* (and previously Information Standard 42 and its guidelines) is to establish a framework for the responsible collection and handling of personal information in the Queensland Government public sector (Queensland Government 2002).

The *Information Privacy Act 2009* (which encompasses the existing Information Standard 42A) sets out the privacy regime for the Department of Health and those statutory authorities for which the Director-General of the Department of Health is the accountable officer (Queensland Government 2003b). Personal information must be managed in accordance with the modified version of the National Privacy Principles adapted from the Commonwealth NPPs contained in the *Privacy Act 1988* (Cth) (Queensland Health 2009; Allens Arthur Robinson 2004). The National Privacy Principles of the *Information Privacy Act 2009* (for the most part) mirror the privacy principles with which private sector organisations are required to comply with under the *Privacy Act 1988 (Cth) (McCullough Robertson Lawyers 2009).*

2.4.2 Right to Information Act 2009

The objective of the *Right to Information Act 2009* is to provide right of access to information under the government's control unless, on balance, it is contrary to the public interest. Government information should be released administratively as a matter of course, unless there is good reason not to, with applications under the *Right to Information Act 2009* being necessary only as a last result (Queensland Government 2008).

The Right to Information reform aims to make more information available, provides equal access to information across all sectors of the community, and provides appropriate protection for individuals' privacy. The *Right to Information Act 2009* creates a legally enforceable right of access to documents of any agency and official documents of a Minister.

The *Right* to *Information Act 2009:*

- Gives the public a right to apply for access to documents held by government agencies and Ministers;
- Requires each government agency to publish a publication scheme on its website which may include an online disclosure log of documents that have been released in response to Right to Information applications; and
- Establishes an Information Commissioner and Right to Information Commissioner to oversee Right to Information in Queensland.

(Queensland Government 2009c)

From 1 July 2009, the *Right to Information Act 2009* replaced the *Freedom of Information Act 1992* and is part of a broader "push" model, whereby government information (unless contrary to the public interest to disclose) is to be made publicly available as a matter of course so as to ensure greater proactive and routine release of information, maximising the public's access to government information (Queensland Government 2009b).

The *Right to Information Act 2009* applies to:

- Queensland Government departments;
- Ministers and Parliamentary Secretaries;
- Local Governments;
- Public authorities; and
- Certain Government-owned Corporations.

(Queensland Government 2009b)

2.4.3 Public Records Act 2002

The *Public Records Act 2002* ensures that the public records of Queensland are made, managed and kept and, if appropriate, preserved in a useable form for the benefit of present and future generations; and to ensure that public access to records under this Act is consistent with the principles of the *Right to Information Act 2009* (previously *Freedom of Information Act 1992* (Queensland Government 2003a)).

2.5 Regulation and electronic health systems

Technology should complement and improve clinical care, not impose extra burdens on already overloaded medical staff. However, systems of electronic health records have proved very difficult to design and implement successfully. Briggs (2000b, p. 21) states that ‘Issues to be overcome include: reassuring consumers that their privacy will be protected; the need to stick to agreed terminology; the challenges surrounding entering data on the record; providing decision support tools which health care providers value; and ensuring access only to authorized users’. Other commonly cited difficulties with SEHRs include issues with data entry, security, user perception, reduced productivity during implementation and disruption to office workflows (Baron et al 2005; Information Management Journal 2009; Scott et al 2005; Walsh 2004). Coupled with the increasingly complex compliance requirements relating to electronic systems, (e.g. how they keep and store patient information etc), SEHR systems face many problems. Neame and Kluge (1999) point out that ‘accepting the benefit of technology is easy; offsetting it against risk is harder’.

Lim (2001) states that the health sector is one of the most heavily regulated industries in Australia, and ascertaining legal and equitable obligations in this environment of regulation can be very challenging. The discussion regarding the number of Standards and Legislation relating *specifically* to health information needs (Sections 2.3 and 2.4) illustrates the vast array of information which care providers need to be aware of. Key questions which need to be addressed for the implementation of SEHR systems include; how much security is enough, who owns the record(s), and who gets to use the data (Detmer & Gillings 2000).

As identified, the collection and use of health information has been identified as a cause for public concern in Australia and also within other countries (Adkins et al. 1998; Bennett 2001; Berner, Detmer & Simborg 2005; Briggs 2000a; Darr et al. 2003; Mulligan 2001; Princeton Survey Research Associates 1999; Privacy Commissioner 2000). Over two decades ago, Naeme and Kluge (1999) illustrated precisely the problem faced by those involved in the innovation process. They stated that, the contribution of computers to health care would be limited by the extent to which users and the community of patients came to trust them to manipulate data and support decisions while protecting their privacy (Naeme & Kluge 1999). This statement is almost certainly more relevant now than at any time previously. Computers are relied upon more than ever in the current technological environment, from storing general patient information through to sending personal information through electronic networks to recipients nationally and internationally. The ability to maintain the integrity and privacy of this information is just as an important factor now as ever.

Privacy considerations may well offer the greatest capability to both foster and limit future prospects of electronic health systems (Detmer & Gillings 2000). Regulation is clearly needed and striking the right balance will be a challenge, particularly for that sector of the population who are very concerned about their privacy (Detmer & Gillings 2000). Consistent regulation across the public and private sectors and stronger private sector regulation of privacy are particularly important in the context of federal government plans for integrated electronic records through the implementation of the PCEHR system (Choice 2000). This is supported through the findings of a Rand Corp. study conducted in the United States, which found that the key to overcoming privacy concerns surrounding the use of electronic health records would come through the creation and enforcement of laws which severely punish those who misuse information retrieved from electronic health records (Information Management Journal 2009). The national PCEHR system, through the *Personally Controlled Electronic Health Records Bill 2011,* will aim to ensure that it meets the legislative requirements imposed on health organisations nationally (such as those identified in Sections 2.3 and 2.4.

General practice has shown its ability to be flexible and responsive with regards to the adoption of information management (Kidd 2002), and must continue to be able to change to respond to the challenges of SEHRs in the future (Martin et al 2004).

2.7 Conclusion

This chapter has focussed on compliance in health care. The range of Legislation and Standards relating to care providers' provision of health information was explored in detail, including the recent *Personally Controlled Electronic Health Records Bill 2011*, introduced for the imminent introduction of the PCEHR System throughout Australia.

Table 2.1 provides a summary of the legislation outlined in this Chapter and the relevance to this study. Table 2.1 also outlines how this research has incorporated the key themes captured from this legislation into this study's questionnaire design in order to identify the factors which have the greatest influence on care providers' willingness to adopt SEHRs.

Table 2.1 Summary of legislation related to health information needs and relevance to current study

	Legislation	Relevance to research	Testing methods
SEHRs	Personally Controlled Electronic Health Records Bill 2011	Establishes the national PCEHR system and regulatory framework. Outlines privacy protections and conditions of use.	This legislation was introduced after the research had been designed. However Part E of the questionnaire deals with a number of issues associated with SEHRs and their implementation.
Privacy	Commonwealth Privacy Act 1988 Commonwealth Privacy Amendment (Private Sector) Act 2000 Section 95 Guidelines Section 95A Guidelines Information Privacy Act 2009	Rules for the collection, use, storage and disclosure of personal information.	Elements of Part B and D of the questionnaire focus on the collection, use and privacy requirements of patient and care provider information.
Information management	Health Records and Information Privacy Act 2002 (NSW) Victorian Retention and Disposal Authority for Patient Information Records (PROS 11/06) Health Records Act 2001 (Vic) Public Records Act 2002	Governance surrounding creation, management, maintenance and disposal of health information.	Elements of Part B, C and D of the questionnaire focus on specific elements of data usage and information management practices.
Security	Healthcare Identifiers Act 2010 Telecommunications Act 1997 Right to Information Act 2009	Ensuring healthcare information is correctly matched to individuals, and rights of access are outlined, and that access is controlled when transmitted electronically.	Elements of Part B and D of the questionnaire focus on practices related to the security and transmission of data.

The identified requirements demonstrate the increase in the volume of Standards and Legislation impacting upon the health sector's information needs over the past ten years. The regulatory environment specifically relating to Queensland was then identified, particularly in relation to the recently released *Information Privacy Act 2009* and *Right to Information Act 2009*. The relationship and associated difficulties between SEHRs and the corresponding regulatory and legislative requirements were then identified, with concerns for the privacy of patient information and the complexities surrounding the legislative environment identified as among the most significant challenges for the implementation of a SEHR system.

The use of technology in health care is explored in depth in the next chapter. Chapter Three examines the background of the SEHR, including looking at the need for the technology, and an overview of Australian initiatives in the area. Chapter Three then establishes the link between Rogers' Diffusion of Innovation theory, Davis' Technology Acceptance Model and the adoption of SEHRs.

CHAPTER 3 – TECHNOLOGY IN HEALTH CARE

Chapter Two addressed legislative issues impacting upon the health care environment. Electronic health systems are now identified in this chapter.

“First do no harm”, is an often quoted term from Hippocrates. Kohn (2000, p.3), states that ‘at a very minimum, the health system needs to offer that assurance and security to the public’.

A reliable system for patient identification, coupled with comprehensive policies and/or legislative acts protecting privacy of individuals and security of personally identifiable information, is a necessary component of the electronic health record implementation process in many health care delivery systems around the world (Health Canada 1998). Ed Hammond (2003) provides an outline detailing his perspective of the vision and need for electronic health systems, for everyone involved in health care. The vision provided by Ed Hammond (2003) is that:

> Providers, those responsible for health, those responsible for paying for health, those setting the policies that determine the nature of health care provided, and most importantly, consumers will have ready access to timely, relevant, reliable, and secure health care data, information and knowledge through an interconnected, electronic health information infrastructure, to drive better health and health care.

3.1 Background to the Shared Electronic Health Record

The development of electronic health records and the sharing of these records provides the foundation for the ‘innovation’ to be developed and implemented in this study. The shared electronic health record (SEHR) is not a recent innovation. The concept of SEHRs began at least 40 years ago, but the first implementations did not begin until the 1980s, and with the exception of a few countries in Europe, is still very low (Royal Australian College of General Practitioners 2004; Reid 2010; Schloeffel 2004a). ‘For over thirty years, there have been predictions that the widespread clinical use of computers was imminent. Yet the ‘wave’ has never broken’ (Berner, Detmer & Simborg 2005, p. 3). However, due to factors such as technology interoperability problems and the previous lack of strong incentives from Governments, the widespread clinical use of computers has previously never progressed past the concept stage. However, the recent diffusion of SEHRs by Government’s (e.g. Australia’s proposed Personally Controlled Electronic Health Record (PCEHR)) has brought the innovation back into the spotlight.

Recently, much work has been undertaken to develop SEHRs to meet specific needs and requirements of various stakeholders. Countries over the past decade who invested significant resources to develop shared electronic health systems, and Standards for these systems include the UK, Netherlands, USA, Indonesia, Australia and Canada (Dearne 2011; Detmer & Gillings 2000; Schloeffel 2004a).

3.2 The Explosion of Online Health Use

Systems such as the current Personally Controlled Electronic Health Record system (see section 3.4) endeavour to provide clinicians with accurate up to date information about their patient when required, at the point of care. Patients however, do not always go to a doctor to seek medical information. Internet use has the potential to overcome problems of distance, status, time and personal schedules that other means of communication cannot (Norris 1999). Anyone with internet access can now obtain online access to electronic versions of major medical journals (e.g. *The Lancet,* the *British Medical Journal,* and the *Medical Journal of Australia*) and an enormous amount of other health related information from a wide variety of sources (Gaby & Henman 2005). The internet provides consumers with access to a wealth of health information and services whereby consumers can now access the same online information as health care providers (Bessell et al. 2002; Burgess, Gray & Fiddian 2004). More and McGrath (2002) state that the internet will topple communication boundaries between consumers, providers, insurers, and health product distribution chains. Briggs (2000c, p. 52) states that in the USA, health information is the most sought after personal information on the internet. There is a veritable explosion of individuals seeking medical information from sources other than their general practitioner (Briggs 2000c). Briggs (2000c, p.52) states that ‘This is a sign of the information society in which individuals routinely seek information to address issues in their daily lives’.

While the telephone took 40 years to reach 10 million people, it only took four to five years for the internet to reach 100 million (Detmer & Gillings 2000). During the 1990s, the internet exploded into public consciousness (Oh et al. 2005). The number of internet users is growing by the day. In November 2000, more than 400 million people around the world accessed the internet (Bessell et al. 2002). The number of online users as of September 2002 was estimated to be 605.6 million (Nua Surveys 2003). By 2004, this figure had grown to 934 million users (ClickZ Stats 2005). In January 2011, UN's International Telecommunications Union announced that the worldwide internet population had reached 2 billion people (Internet Worldwide Stats 2011; *The Australian* 27 Jan. 2011). The Draft Concept of Operations (National E-Health Transition Authority 2011) for the PCEHR systems states that Australia is one of the more information and communication technology enabled societies in the world. At the end of December 2010 there were 10.4 million active internet subscribers in Australia, with 81% of subscribers having a download speed of 1.5Mbps or greater (ABS 2011).

Consumer use of the internet has the potential to benefit or harm consumers who use it to manage their health. The quality of information and services on the internet is variable and not regulated (Bessell et al. 2002). Some of the health information available on the internet is quality, evidence-based information and some of it is questionable – or at least not accepted by the medical profession – and potentially misleading and dangerous (Gaby & Henman 2005). In addition, some of the health information available on the internet may be commercially biased if it endorses a particular product or treatment developed by an individual or pharmaceutical company (Fry 1999; Gaby & Henman 2005; Hardey 2001, 2002). With the magnitude and diversity of information available, there are problems in determining its credibility, relevance and accuracy (Jadad & Enkin 2000). Dunne (2003) states that there is evidence to suggest that relying on Web sites for health care information can be harmful. The greatest danger lies in self diagnosis based on unreliable information. Legislation aimed at protecting consumers from fraudulent health care claims and practices lacks the development of technology and is difficult to enforce due to the global and open nature of the internet (Bessell et al. 2002).

Consumers use internet based information to shape treatment preferences and select health care providers (Bessell et al. 2002). Consumers seek online consultations, support, self management and screening tools, and buy medicines online. Health care services can now be delivered by virtual health care providers, located anywhere in the world, to consumers who never have to leave home (Bessell et al. 2002; National E-Health Transition Authority 2011). The internet consumer market was projected to reach US$1.7 billion in 2003 (Detmer & Gillings 2000). In 2012, it is estimated that this value is significantly higher, reflecting the growth in the internet and its uses.

As illustrated in this section, consumers are embracing internet technology in order to seek health care, whether it is a general enquiry, extending to purchasing products or seeking treatment. The primary problem as identified with the extensive use of the internet for health use is the degree of accuracy of the information attained. Therefore, as stated by Ed Hammond at the beginning of this chapter, '…providers and consumers need ready access to timely, relevant, reliable, and secure health care data,… to drive better health and health care.' Through the development of a national SEHR system and through the use of computers or mobile devices with internet access, consumers can check their medical history and receive the most up to date information anywhere, anytime.

3.3 Defining Electronic Health Records

An electronic health record provides each individual with a secure and private lifetime record of their key health history and care within the health system. The record is available electronically to authorised health care providers and in selected instances to the individual anywhere, anytime, in support of high quality care (Health Canada 2004, p. 3). 'The introduction of an electronic record should enable healthcare workers much greater access to timely, reliable and accurate data' (Conrick 2006, p. 12). In addition, Conrick (2006, p.12) states that 'great gains are envisioned at the hospital interface, where quick access to a patient's medication record could be life saving'.

Schloeffel (2004b) states that the International Standard ISO 20514 defines an electronic health record as:

> A repository of information regarding the health of a subject of care in computer processable form, stored and transmitted securely, and accessible by multiple authorised users. It has a commonly agreed logical information model which is independent of EHR systems. Its primary purpose is the support of continuing, efficient and quality integrated health care and it contains information which is retrospective, concurrent and prospective.

In addition to the International Standard, Briggs (2000c, p. 18) provides the following definition of electronic health records that was developed for the Australian system, HealthConnect:

> An electronic longitudinal collection of personal health information, usually based on the individual, entered or accepted by health care providers, which can be distributed over a number of sites or aggregated at a particular source. The information is organized primarily to support continuing, efficient and quality health care. The record is under the control of the consumer and is stored and transmitted securely.
>
> It is any information relating to the past, present or future physical/mental health, or condition of an individual which resides in electronic system(s) used to capture, transmit, receive, store, retrieve, link, and manipulate multimedia data for the primary purpose of providing health care and health related services.

Based on the definitions previously identified, there appears a common link. Both discuss electronic information (past and present) about individuals which can be shared between users, with the aim of improving health care and health services.

Additionally, Schloeffel (2004b) states that the International Standard ISO 20514 defines an electronic health system as:

> A system for recording, retrieving, and manipulating information in electronic health records, or more broadly as the set of components that form the mechanism by which electronic health records are created, used, stored, and retrieved. It includes people, data, rules and procedures, processing and storage devices, and communication and support facilities

As briefly identified previously, it is over four decades since information technology (IT) was first introduced to Australian general practice. Early work in medical informatics focused on clinical computing with a clear goal – to improve clinical decisions and reduce medical errors – essentially though electronic access to procedure results, faster access to relevant medical information in the literature, and, from the beginning, decision support functions such as reminders and alerts (Berner, Detmer & Simborg 2005). In the 1970s, its use centred on collating patient data, and the possibility of electronically linking primary and secondary care emerged. In the '80s computers were introduced to the consulting room; and in the '90s the internet provided the potential to obtain and review useful information during the consultation (Mitchell & Sullivan 2001; Richards et al. 1999). Today, in addition to providing care providers' with a number of clinical benefits (outlined in 3.3.1) such as up to date information, SEHRs are proposed to enable the secure sharing of health information between an individual's healthcare providers, whilst enabling the individual to control who can access their electronic health records (Commonwealth Department of Health and Ageing 2011).

3.3.1 The Role of Technology and Shared Electronic Health Records in Health Care

The adoption and implementation of SEHR systems consists of a range of initiatives which inevitably initially involve the introduction of new health information technology (IT) to support SEHR systems. Health IT is regarded as an essential tool for hospitals navigating the road to patient safety and implementation of SEHRs (Furukawa et al. 2008). Successful implementations of health IT systems has the potential to positively influence care providers' willingness to adopt SEHRs. Research suggests that user attitudes towards IT systems are a critical factor in influencing care providers' willingness to adopt SEHRs (Castillo et al. 2010; Shar et al. 2006; Zheng et al. 2005).

Implementation of health IT systems provides the opportunity for a number of high level organisational benefits. These benefits include improvement to organisational workflows, improved interoperability between systems, improved technical support and improved communication among users (Castillo et al. 2010).

Health IT systems are becoming increasingly critical in the daily roles of care providers'. For example, General practice is central to the coordination of health care provision with 85% of Australians interacting with a general practitioner each year (Britt, Miller & Charles 2007). It is reported that 98% of Australian general practices are computerised, with 64% recording clinical information in the form of progress notes (Australian Doctor, 2010; McInnes, Saltman & Kidd 2006). Further, a Royal Australian College of Physicians survey of 1,266 Specialists found that 97.5% of respondents had access to computers at work (Osborn et al. 2009). Today, the use of technology in health care has extended to include mobile devices such as tablets and smart phones. Mobile devices offer flexibility and ease of access to patient information (Dumaine 2012; Solomon 2011). In addition to care provider use of mobile technologies, customers are using a range of mobile devices to view patient medical records such as history, medication and problem lists, and allergies (GE 2011).

Further to the role played by health IT systems in general, the development of SEHRs has been credited with improving efficiency in health care; has the potential to increase the quality of care in hospitals, and reduce costs of clinical care (Burke & Menachemi 2004; Carayon et al. 2009; Darr et al. 2003; Commonwealth Department of Health and Ageing 2011; Francisco 2011; Glaser 2009; Lorence & Jameson 2002; Peterson et al. 2009; Stephenson 2011; Watkins et al. 2009). Clinical users consider that computers offer benefits to doctors, patients and the government.

For example, studies in America have found that SEHRs have provided impressive cost savings and patient benefits. An October 2009 RAND Corp. study of 305 groups of primary care physicians in Massachusetts found that medical practices with electronic health records “Were more likely to deliver better care for diabetes and provided more types of health screenings than those who did not.” (Reid 2010). Additionally, a study reported by Hypatia Research, LLC found examples of significant cost savings. The report highlights a handful of specific examples including cardiology consultants in Pennsylvania who experienced an 88% reduction in transcription costs and saved $350,000 on filing-clerk staff and the MedCentral Health System of Ohio that eliminated radiology film costs of $450,000 (Reid 2010).

Generally, following the implementation of SEHRs, healthcare providers are deemed to benefit via availability of information at the point of care, better information storage and retrieval, efficiency of storage space and time, more accurate records, improved drug management, improved legibility and presentation, better security and integration of clinical and administrative functions (Commonwealth Department of Health and Ageing 2011; Jefferson 1998). Shared electronic health records enable patients to have easy-to-access information about their medical history, including medications, test results and allergies, allowing them to make informed choices about their healthcare and be active participants in their healthcare (Commonwealth Department of Health and Ageing 2011). Additional benefits to patients include improved prescribing of medications, improved referrals (based on the patient summary) and access to computer based patient education materials. In addition, the Commonwealth Department of Health and Ageing (2011) and Jefferson (1998) state that the government and healthcare system in general is believed to benefit from cost savings, reductions in preventable hospitalisations, delivery of better coordinated healthcare, reductions in the number of avoidable adverse events and costly unnecessary treatment activities, control over doctors, control over 'doctor shoppers' and access to national health data.

There are heavy expenses nation wide with the duplication of diagnostic tests (Dearne 2005a). 'That can certainly come down if we have readily available health records so that blood tests, X-rays and MRI's do not need to be repeated by every lot of treating doctors', stated then Federal Health Minister, Mr. Abbott (Dearne 2005a).

There is potential for the quality of health care to be enhanced through appropriate applications of information technology. The then Federal Health Minister Tony Abbott said 'we believe upwards of 3000 people a year die prematurely because of inadequate information and recordkeeping (Dearne 2005a). 'We're never going to be able to eliminate that, but we think we can avoid quite a few of these unnecessary deaths if we have an integrated records system' he stated (Dearne 2005a).

Despite the potential benefits, access to patient records has previously often been incomplete and disorganised. This was due to the decentralized and defragmented nature of health systems (Commonwealth Department of Health and Ageing 2011; Kohn 2000). This is supported by Briggs (2000b), who states that, 'the majority of health care records in Australia exist as discrete paper based entities held at a variety of different locations, resulting in a fragmented picture of individuals' health needs and health histories'. Medical records can typically be stored in separate systems across GPs, hospitals, emergency departments, outpatients' clinics, diagnostic units and specialists' rooms. A clinician therefore could access only those records stored in their own files, while access for patients was extremely limited (Aap 2004). In a study conducted by the RAND Corp. in the United States relating to the creation of an electronic health system through a unique patient identification number for every person, a number of benefits were realised. These benefits included a reduction in medical errors, increasing the overall efficiency of patient treatment, and protection of patient privacy (Carayon 2009; Information Management Journal 2009).

The development of an integrated SEHR network has the potential to benefit patient care substantially. The Commonwealth Department of Health and Ageing (2011) states that the purpose of SEHRs is to address the information fragmentation that currently exists in relation to personal health information. Further, Briggs (2000b, p.8) states that 'Electronic records and transmission of personal health information can provide a powerful tool to link the isolated islands and fragments of information that currently exist'.

The General Practice Strategy Review Group states that 'good information management and communication are believed to be central to enhancing the quality of the care delivered by general practitioners' (Royal Australian College of General Practitioners 2004, p. 73). Lorence and Jameson (2002) add to this statement, arguing that in day to day practice, reliable data quality can enhance the judgment that individual clinicians acquire through training and practice. Increased clinical performance is thus achieved in many ways, especially through better informed diagnosis and in more complete identification of treatment options (Lorence & Jameson 2002). A majority of health care executives believe SEHR systems will have a positive long term financial impact on their organization, despite costs and other barriers to adoption (McGee 2004). The key is not the technology, but how the technology can be utilised to reinvent health care (Berner, Detmer & Simborg 2005).

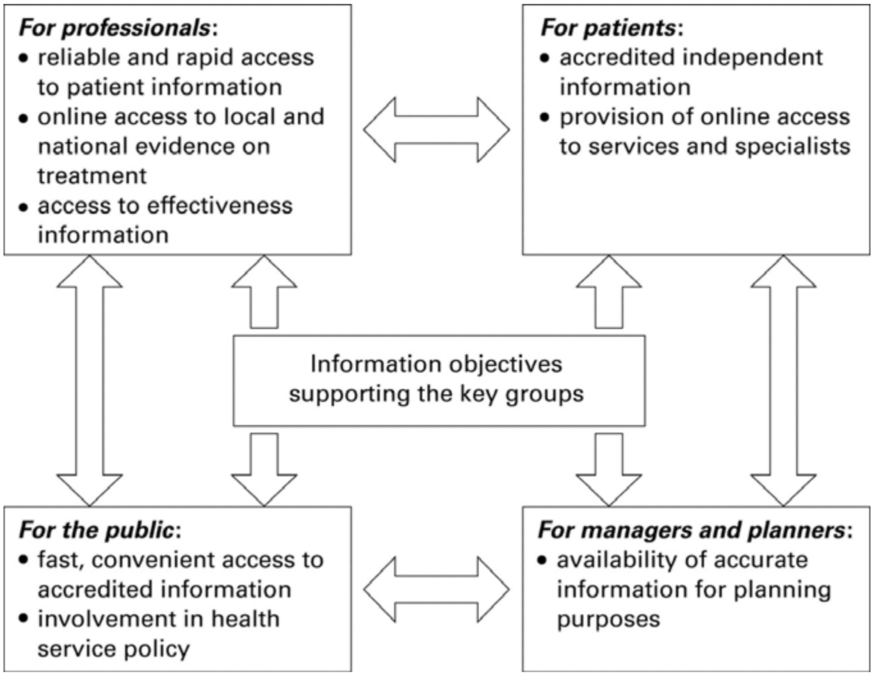
The current Australian healthcare system operates in a mixed mode of using paper-based and electronic-based systems for collecting and sharing health information. A number of different eHealth applications are in wide use in a number of different areas in the health sector including patient administration systems (PAS), clinical information systems (CIS), diagnostic imaging systems, pathology systems, and practice management systems (National E-Health Transition Authority 2011).

As clinical computer use in general practice becomes more widespread, evidence of its benefits is being accumulated. For example, ‘computerised prescription software packages that are being used widely in Australian general practice and have the potential to improve the quality use of medicines through providing the general practitioner with information about medications, access to clinical guidelines and warnings about potential contraindications, adverse reactions and allergies’ (Dumaine 2012; Royal Australian College of General Practitioners 2004, p. 74). Prescriptions are legible and accurate and allow audits of prescribing for individual patients and the practitioner’s patient population. Individualised consumer medicine information can be produced at the time a prescription is generated (Royal Australian College of General Practitioners 2004).

3.3.2 Shared Electronic Health Records in an Information Society

In 2000, Briggs stated that ‘a new “information society” was emerging, in which management, quality and speed of information are key factors for competitiveness’ (Briggs, 2000c, p.52). As identified in the previous section by Jefferson (1998) and now by Detmer and Gillings (2000), there are various groups involved within health care (professionals/care providers, patients, public/Government and managers/planners) which all have information requirements. The information requirements of these groups are depicted in Figure 3.1

Figure 3.1 Information Requirements

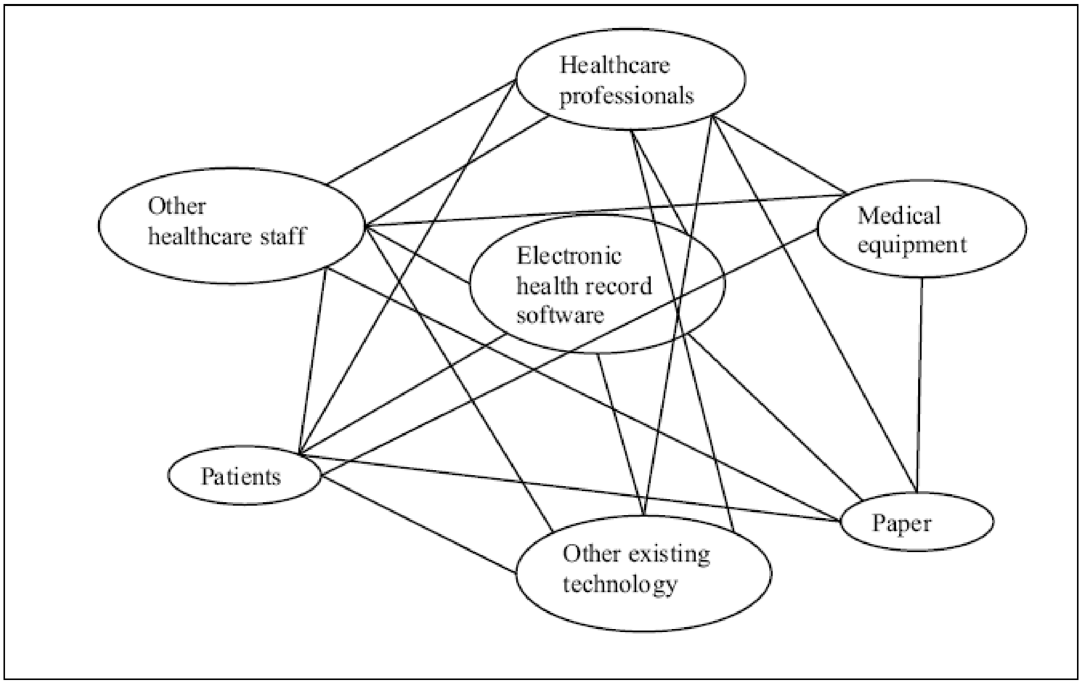


Detmer & Gillings 2000, Reproduced from *Information for Health: An Information Strategy for the Modern NHS1998–2005"*

Figure 3.1 provides an overview of the general information requirements of the various groups involved within the health care environment. When translated to the SEHR environment, Cresswell et al. (2010) states that the implementation of SEHR systems require the formation of new information relationships. Within the United States, to meet the need for information of the various groups involved in health, federal and regional efforts are under way to accelerate the adoption and use of SEHRs as a means of facilitating clinical data sharing (to improve the exchange and use of health-care information among different care providers and between care providers and patients), protect health information privacy and security, and quickly identify emerging public health threats (Overhage et al. 2005; Stephenson 2011; Thompson and Brailer 2004).

Cresswell et al. (2010) provide the following diagram (Figure 3.2) to illustrate the new relationships between those involved in the health system following the implementation of a SEHR system.

Figure 3.2 Information networks in relation to the introduction of a SEHR system



(Cresswell et al. 2010, *Actor-Network Theory and its role in understanding the implementation of information technology developments in healthcare*)

From the information provided thus far, it can be seen that information is central to improving health care quality and safety (Royal Australian College of General Practitioners 2004). As illustrated in Figures 3.1 and 3.2, the various groups involved either directly or indirectly in the health care system all need information to assist in making decisions. In order to support the various information requirements for all identified groups, Hare (2001) states that information technology is becoming an increasingly important component of primary care.

3.4 Australian initiatives in e-health

Early trials conducted throughout the past decade have confirmed the early evidence that health care quality can be significantly improved through health information (Detmer & Gillings 2000). Over the next two decades, e-health could deliver a positive impact on quality and access of health care. These early studies have found that these positive impacts are likely to improve cost effectiveness of health care, which should lead to better evaluation of health status and outcomes (Commonwealth Department of Health and Ageing 2011; Detmer & Gillings 2000). In addition, Detmer and Gillings (2000) state that a benefit of allowing patient access to electronic health systems is that more knowledgeable patients will likely support rising standards of medical care and research and result in better management of the knowledge base. These findings from Detmer and Gillings in 2000 remain relevant today, with the *Concept of Operations: Relating to the introduction of a Personally Controlled Electronic Health Record System* (National E-Health Transition Authority 2011) containing a number of the same benefits for individuals and healthcare providers alike, stating the system will enhance the way healthcare is delivered (additional benefits outlined in Section 3.5).

Across Australia, many programs have been, and are currently being undertaken to provide not only doctors and GPs with adequate electronic medical access, but also patients. Prior to 2010, a number of SEHR initiatives have been developed. The *Concept of Operations* document referred to above (National E-Health Transition Authority 2011) for the personally controlled e-health records (PCEHR) system summarises the history of Australian initiatives relating to eHealth. Consideration of SEHRs in Australia started with the National Electronic Health Records Taskforce (NEHRT) in 2000, which was commissioned by the Australian Government to consider the potential for a network of electronic health records. The recommendations of the NEHRT led to the creation of the HealthConnect program and work on a range of trials on SEHRs progressed initially through HealthConnect and MediConnect programs in Tasmania, Queensland, New South Wales, South Australia, Western Australia and the Northern Territory.

In addition to the above trials, in 2004 New South Wales developed a $19.4 million pilot program called Health e-link. As part of Health e-link, clinicians and patients in NSW could retrieve information including prescriptions issued, blood test results, x-rays and hospital discharge notes for example. Tests would not have to be repeated unless absolutely needed, nor would patients and carers have to recall from memory all aspects of care they received in the past (Aap 2004). This initiative allowed patients to access their full medical records online. In addition, health professionals – including GPs, specialists and emergency department clinicians – were able to see a patient's detailed medical history (Aap 2004).

In 2005 it was recognised that for eHealth to progress further in Australia, key infrastructure and standards were required, and the National E-Health Transition Authority (NEHTA) was established. The development of the PCEHR system is a result of the NEHTA, and follows on from the HealthConnect initiative.

3.4.1 HealthConnect

The HealthConnect initiative was a partnership between the Australian, State and Territory Governments. The initiative aimed to improve safety and quality in health care by facilitating the development and establishment of a range of standards based products and services that would enable the secure exchange of information between health care providers and consumers. Privacy, security and timeliness of information flows to improve the delivery of health services were the key drivers of this initiative (Australian General Practice Network 2007).

HealthConnect was Australia's first health information network. The network involved the collection, storage and exchange of consumer health information via a secure network and within strict privacy safeguards to provide better integration of care and improved outcomes across the health care system (Health Connect 2004b). Government literature outlined that 'HealthConnect is a new national framework that, with consumer consent, will allow the electronic exchange of clinical information between health care providers. Everything from hospital discharge summaries and prescriptions to pathology results will be readily available when it is needed, where it is needed' (Health Connect 2004a, p. 2).

To demonstrate the importance and significance of the project, the Australian government stated they would provide $128.3 million over the four years from 2004 – 2008 towards the expected nation wide implementation of the national health information network, as a major platform for reforming health care delivery in Australia (Health Connect 2004b).

A national approach was designed to create greater coherence, establish national standards and provide a framework for compatible systems across the nation – so that information can be exchanged at a clinical level no matter what state or regional borders are being crossed (Briggs 2000a). Therefore, '…a national HealthConnect network is expected to realize significant health sector savings for the Australian, State and Territory governments by contributing to safer, more efficient and more effective health care' (Health Connect 2004a, p. 5). These primary benefits continue to be diffused towards care providers' with the current PCEHR system in order to gain a greater level of acceptance, and therefore an increased willingness to adopt.

3.4.2 Personally Controlled Electronic Health Records

The most recent update on Australian initiatives in SEHRs is the move towards personally controlled electronic health records (PCEHR). In April 2011, the Commonwealth Department of Health and Ageing released a 'concept of operations' for the Federal Government's $466.7 million PCEHR system set to be made available to the general public from July 2012 (ZDNet 2011). In a statement made by the then Minister for the Commonwealth Department of Health and Ageing Nicola Roxon, the Minister reported that:

> Any person who chooses to, from 1 July next year, will be able to be part of an electronic health system, and what that means is that important information about you can be accessed by you at any computer, and probably any iPhone and Blackberry, into the future, which will have your current medications, any particular

> allergies, information that you might want stored there about emergency contacts and others, will be on the system.
>
> (National E-Health Transition Authority 2011)

The PCEHR system is Australia's national approach to SEHRs. The national solution extends the concepts of SEHRs and includes the required infrastructure and legislative requirements necessary to implement such a comprehensive solution. The *Concept of Operations* maps out the SEHRs function, possible information as well as proposed security and privacy settings and how the system will connect with clinical systems.

The PCEHR system focuses not only on health care administration, but also enables the secure sharing of health information between an individual's healthcare providers, while enabling the individual to control who can access their PCEHR (Commonwealth Department of Health and Ageing 2011).

According to the *Concept of Operations,* the proposed system will give end-users access to a consolidated view of their medical history via a customer-facing online portal. End-users will also be able to access the system via a government-operated call centre. From the portal, a user can:

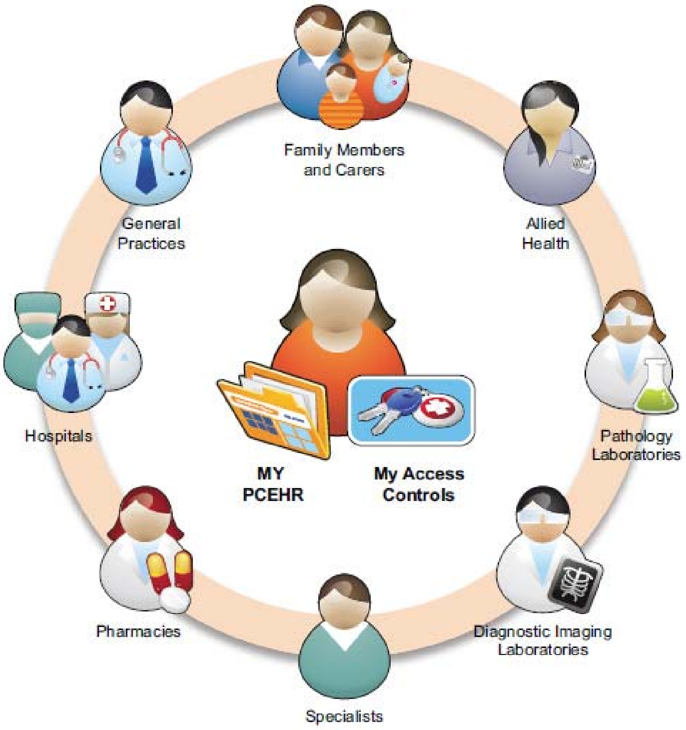
- Access general information about the PCEHR system;
- Register, deactivate and re-activate a PCEHR;
- Nominate new representatives for the PCEHR;
- View, download and print clinical documents;
- Manage access controls and view who has accessed their health data and how; and
- Access help services.

(ZDNet 2011).

When patients visit their local GP, specialist or emergency department, the PCEHR system will allow the care provider to access patient health records at a click of a button.

The national PCEHR system places the consumer at the centre of their own healthcare by enabling access to important health information, when and where it is needed, by the consumer and their healthcare providers (Department of Health and Aging 2011). With the consumer's permission, key pieces of health information may be viewed by participating healthcare providers across different locations and healthcare settings. Building upon the information flows highlighted Figures 3.1 and 3.2, Figure 3.3 below provides an overview of the different participants in the PCEHR system.

Figure 3.3 PCEHR System concept



Commonwealth Department of Health and Ageing, 2011, *Concept of Operations: Relating to the introduction of a Personally Controlled Electronic Health Record System.*

The implementation of a national e-Health system addresses one of the greatest challenges faced by the Australian health system — the fragmentation of information spread across a vast number of different locations and systems (National E-Health Transition Authority 2011). The Commonwealth Department of Health and Ageing and the National E-Health Transition Authority (NEHTA) is currently working with each of the Australian State and Territory Health Departments to implement a range of foundations, including Healthcare Identifiers, Discharge Summaries and Secure Messaging, all of which will be required for the PCEHR System (National E-Health Transition Authority 2011).

3.5 Specific Benefits of SEHR initiatives

A Capgemini survey, conducted in the U.S. of October 2004, found that of 84 executives from hospitals; health insurers, physician groups, and health care business technology vendors in the U.S., 70% expected that e-health records would provide financial and clinical value to their organisations (McGee 2004). Surveyed organisations indicated that once a system had been up and running for five years, it was estimated that they would each save an estimated US$15 million annually. These savings were based on the elimination of unnecessary or redundant tests on patients, reducing medical errors, and simplifying processes that require manual paperwork by clinicians and other health care workers (McGee 2004). In addition to the financial and clinical values identified above, a 2003 survey by the Healthcare Information and Management Systems Society in the United States found that all 247 respondents agreed that technology can address patient safety issues, and 93% believe that reducing medication errors is the best use of technology (Newbold 2004). This data relates closely to one of the main aspects of this research – the possible relative advantage gained from introduction of SEHRs.

Supporting the findings from the Capgemini survey, the HealthConnect Implementation Approach Report suggests, ‘it is important to recognize that many of the major benefits will only be realised in the longer term’ (Dearne 2005b). In addition, in order to help realise these benefits, ‘it is also important that eHealth initiatives become part of the health system as early as possible so efficiencies and benefits can be leveraged to encourage further uptake' (Dearne 2005b). The Royal Australian College of General Practitioners (2004) found that finding ways to promote the rapid adoption of information technology to improve information management is seen by many as the single most important step towards implementing electronic health systems.

The electronic nature of SEHR initiatives enables consumer health information to be more readily shared. These initiatives aim to provide important medical information where it is needed, at the point of care, potentially saving time, money and most importantly thousands of lives every year (Health Connect 2004a). Sandow-Quirk (2001, p. 313) states that 'what you do not know can hurt you. Sometimes this can be murder'. The introduction of a system such as PCEHR will help to ensure that doctors have all the information necessary at hand.

The HealthConnect and PCEHR system documentation outlines benefits specifically to consumers, care providers and the community. Benefits for consumers are likely to include:

- Easy-to-access and up to date information about their medical history - including medications, test results and allergies;
- Providing consumers with greater control over who has access to their health information and how it can be used for their benefit;
- Ability to present for treatment anywhere in the country, and give permission for health professionals to access their relevant history at the touch of a button;
- Control over what is stored on patient medical records and the ability to decide which medical professionals can view or add to their files;
- Offering the ability to access and read their own personal health information and therefore be better informed and empowered to manage their own care;
- Ensuring that consumers do not need to recall the finer details of their medical history each time they see a different health care provider; and

- Improving patient safety and reduce adverse events, including adverse drug events.

(Commonwealth Department of Health and Ageing 2010b; Health Connect 2004a, p. 4; Legal Information Access Centre, 2001)

Benefits for health care providers:

- Reduction in medical errors through improved patient information;
- Reduction in unnecessary tests;
- GPs will have timely access to clinical information from other providers such as hospital discharge summaries and diagnostic tests;
- Prescribed medicines information can be automatically transmitted to from a GP's desktop into a pharmacies dispensing computer system;
- Hospitals will be able to access consumer's pre-admission health information and then provide electronic discharge records to GP's and other community based allied health care providers; and
- Enhanced management of chronic and complex diseases.

(Australian General Practice Network 2007; Commonwealth Department of Health and Ageing 2010b; Health Connect 2004a, p. 4)

Benefits for all Australians:

- The safety, quality, effectiveness and efficiency of the Australian health care system will be improved through the use of the information held in PCEHRs;
- Providing a much faster, more efficient system of delivering information;
- Improvement in the level and quality of data available for health policy and planning purposes; and
- Researchers will be able to establish a more detailed picture of Australians' health using de-identified information.

(Australian General Practice Network 2007; Commonwealth Department of Health and Ageing 2010b; Health Connect 2004a, p. 5; Legal Information Access Centre, 2001)

Further, initiatives such as PCEHR will provide savings specifically in the following areas:

- Reduced cost of treating adverse events, including hospital residential care, medical and pharmaceutical treatment;
- Improved continuity of care for individuals accessing multiple healthcare providers;
- Reduced duplication of treatment and testing through improved coordination of care, especially for complex and chronic conditions; and
- Improved medication management, which is likely to yield direct savings as well as adding to the safety and efficacy of care.

(National E-Health Transition Authority 2011; Health Connect 2004a).

Findings so far have provided evidence of the relationship between computerisation and some measures of practice quality. The benefits of the use of technology for patient care is supported by Conrick (2006), who asserts that clinical practice has and will continue to benefit from the application of information technology. Part of improving the quality of decisions is having the right information at the right time (Detmer & Gillings 2000). The exponential rate at which information is added to a person's accessible knowledge makes it difficult for individuals to sift through the information, find what is relevant and discard the irrelevant to make a decision. Clinicians need rapid access to reliable information for decision-making (Estabrooks et al. 2003).

3.5.1 Using the Benefits of SEHRs to Promote Implementation Arguments For Electronic Health Systems

Shared Electronic Health Records constitute a significant technological advance in the way medical information is stored, communicated, and processed by the multiple parties involved in health care delivery (Angst & Agaral 2009). Perhaps one of the strongest arguments used to support the introduction of SEHRs is the potential for the technology to reduce medical mistakes.

3.5.1.1 Medical Mistakes

Betsy T Lehman, died from an overdose during chemotherapy. Willie King had the wrong leg amputated. Ben Kolb was eight years old when he died during “minor” surgery due to a drug mix-up (Kohn 2000). These graphic examples illustrate simple errors which can be made during patient care, having significant consequences to patients. However, Kohn (2000) emphasise that the problem is not bad people, the problem is that electronic health system needs to be made safer. The examples previously provided demonstrate the results of poor manual systems, illustrating the need for electronic health systems to aid in the clinical process. As stated by Dean Settig in Detmer and Gillings (2000, p. 186), *‘We don’t need expert systems. We need mediocre systems to keep us from doing stupid things.’*

Kohn (2000, p.4) defines an error as ‘the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim’. Errors can occur for a number or reasons. According to noted expert James Reason in Makeham et al (2002), errors depend on two kinds of failures: either the correct action does not proceed as intended (an error of execution) or the original intended action is not correct (an error of planning). Additionally, the Royal Australian College of General Practitioners (2004) state that errors can be categorised as either process (e.g. office administration, investigation, treatment, communication, payment, healthcare workforce management) or knowledge and skill based (e.g. execution of clinical task, diagnosis, wrong treatment decision with right diagnosis). Regardless of the type of error, all can ultimately lead to the same consequence.

A 1999 report by the Institute of Medicine, "To Err Is Human," found that an estimated 98,000 preventable deaths occurred each year in the United States due to medical errors. The following extract from the report (Kohn 2000, p. 1) illustrates the impact that medical errors can have on society:

> Two large studies, one conducted in Colorado and Utah and the other in New York, found that adverse events occurred in 2.9 and 3.7 percent of hospitalizations, respectively. In Colorado and Utah hospitals, 6.6 percent of adverse events led to death, as compared with 13.6 percent in New York hospitals. In both of these studies, over half of these adverse events resulted from medical errors and could have been prevented. When extrapolated to the over 33.6 million admissions to U. S. hospitals in 1997, the results of the study in Colorado and Utah imply that at least 44,000 Americans die each year as a result of medical errors. The results of the New York Study suggest the number may be as high as 98,000. Even when using the lower estimate, deaths due to medical errors exceed the number attributable to the 8th-leading cause of death in the US. More people die in a given year as a result of medical errors than from motor vehicle accidents (43,458), breast cancer (42,297), or AIDS (16,516). Total national costs (lost income, lost household production, disability and health care costs) of preventable adverse events medical errors resulting in injury) are estimated to be between $17 billion and $29 million, of which health care costs represent over one-half.

According to Claburn (2004), the situation has not improved since the 1999 report identified. A July 2004 report by HealthGrades Inc. - a health-care ratings, information, and advisory services company; noted that nearly half a million lives have been lost needlessly in the five years since the Institute of Medicine report appeared (Claburn 2004).

In a 2005 Australian study, a report by the Patient Safety and Clinical Quality Program detailing adverse incidents, found that 31 people died or were seriously harmed by medical errors in NSW public hospitals in the period covering 2003 and 2004 (Aap 2005b). The report catalogued 452 errors considered capable of causing serious patient harm, including two patient deaths as a result of them being given the wrong medication (Aap 2005c). The report found that system errors were predominantly at fault, and the document highlighted the importance of reporting adverse outcomes to make the health system safer (Aap 2005c).

The findings and implications of the 1995 Quality in Australian Health Care Study suggests that hospital errors - adverse events and complications caused by healthcare, are responsible for up to 18000 deaths annually in Australia (Hass 2005; Health Connect 2004a). These findings mirror the US experience where medication errors alone have been shown to account for three out of every 1000 patient deaths and an additional one in 1000 patients sustaining permanent disability. Seventy-eight percent of these deaths could have been avoided by the use of more sophisticated systems (Health Connect 2004a).

Errors are responsible for an immense burden of patient injury, suffering and death. Errors in the provision of health services, whether they result in injury or expose the patient to the risk of injury, are events that everyone agrees just should not happen (Kohn 2000).

Errors can happen in all stages in the process of care, ‘from diagnosis to treatment, to preventative care’ (Kohn 2000, p. 4). Types of errors are many and varied. Common causes of medication errors in daily hospital practices include improper doses, mix-ups of drugs or patients, and inaccurate records (Kohn 2000). Illegible and incomplete handwritten medical records can also lead to mistakes being made (Aap 2004). Puskar et al (2004) states that illegible handwriting is a cause for up to 15% of medical errors. Medication related errors occur frequently in hospitals; not all result in actual harm, but those that do are costly (Kohn 2000). Shared electronic health records will help to eliminate these errors. For example, in the UK, contracts have been set that will run until 2013 to provide electronic patient records. Over this timeframe, with the exception of patient-held records, written medical records will largely be phased out and replaced by computerised patient records (Chan, Brew & de Lusignan 2004).

Deployment of SEHRs have the potential to reduce costs, including those related to medical mistakes that occur when doctors and clinicians do not have comprehensive and timely access to patient information such as drug allergies and medical histories (Information Management Journal 2009; McGee 2004). Within Australia, two to three percent of hospital admissions are linked to medication errors. This equates to

190,000 admissions each year and costs the health system $600 million (Commonwealth Department of Health and Ageing 2011). Guan (2011) reports that SEHRs will help prevent medication errors that cause the estimated 190,000 hospital admissions each year. A study of two Sydney hospitals has found that SEHRs could drastically cut hospital medication errors. Corderoy (2012) states that the study found a significant and very large reduction in overall prescribing error rates and in serious errors in those hospitals using SEHRs. The study looked at both procedural (e.g., incomplete, unclear medication orders) and clinical (e.g., wrong dose, wrong drug) orders, and rated the severity of the errors (minor to serious). The researchers found that where the SEHR system was implemented, the procedural prescribing error rates fell by over 90% (Corderov 2012).

Access to appropriate information at the time of care delivery is central to good clinical decision making – practitioners and consumers need the right information at the right time (Briggs 2000c). The Commonwealth Department of Health and Ageing *PCEHR Legislation Issues Systems Paper* (2011) states that availability of clear and promptly available information will reduce hospital admissions caused by medication errors, avoid unnecessary tests and save scarce health resources.

As established throughout this Chapter, access to accurate and up to date information in clinical care is vital. A significant cause of preventable death and serious illness is inappropriate treatment based on poor or insufficient information about consumers' medical history (Health Connect 2004a). It had been widely hypothesized that physicians' errors of omission and commission were at least as frequently related to their lack of information about the patient as they were to lack of medical knowledge (Berner, Detmer & Simborg 2005, p. 4). In a series of reports over the last 15 years, the Institute of Medicine (IOM) has highlighted that wider use of information technology in health care is essential for major improvements in the quality of care (Berner, Detmer & Simborg 2005, p. 3). 'Shared electronic health records will be a significant contributor to increased consumer safety. A US report points out that the annual toll from preventable errors exceeds the combined number of deaths and injuries from road and air crashes, suicides, falls, poisonings and drownings' (Briggs 2000c, p. 16).

However, while SEHRs can provide many benefits, it is important that they are maintained to keep only the most up to date information. For example, in Australia January 2005, an audit of the government health system by the Australian National Audit Office found that up to 500000 dead people were found to have an active Medicare number, leaving the health system exposed to serious fraud and identity theft (Aap 2005a; Noble 2005; Riley 2005). This illustrates the need for continuous maintenance of e-health systems.

For SEHR systems such as the PCEHR to deliver on its potential, like all major change programs, PCEHR needs a continuous, rigorous and consistent focus on the achievement of benefits. Although purchasing activities are a major component of the marketplace, health care is not driven by only economic factors. This approach contrasts with the traditional project orientation, where success is typically achieved by delivering a capability on time and on budget (Parker, Hewitt & McWilliam 2004). Incentives come from other directions as well, including the norms, values and standards of health professionals and social values of communities. Professional groups, such as medical societies, specialty groups and associations, play a role in defining norms and standards of practice, and setting expectations and values, beginning with training and education and continuing into practice (Kohn 2000). Attaining advice from professional groups etc. when developing an innovation will help with the social system gaining acceptance of a SEHR system, and have the effect of potentially increasing the rate of adoption within a shorter period of time (RACGP 2011). If professional groups can help in ensuring that an innovation is consistent and compatible with existing norms and standards, then the potential willingness to adopt could be improved.

A consistent finding across a number of international studies suggests that a 'middle out' approach based on collaboration between government, the ICT industry, and healthcare providers to create an evolving set of standards and promote dialogue across sectors promotes the greatest likelihood of success of implementation of SEHR systems (Coiera 2009; Devlies et al. 2008).

In addition to the success factors identified above, the findings from this study may prove valuable in identifying other specific success factors specifically relevant to care providers' willingness to adopt SEHRs. Specific variables influencing willingness to adopt may be able to be targeted during the adoption and implementation phases of that national PCEHR system.

3.5.2 Counter Arguments Against the Implementation of SEHRs

Despite the evidence of the benefits associated with quality information, at the point of patient care, the recognition that SEHRs could improve health care quality, reduce medical errors, and reduce health care costs is still not sufficient motivation to overcome resistance to the system's adoption. Without strong physician demand, Berner, Detmer and Simborg (2005) state that hospital and practice administrators do not see sufficient potential financial return to try to overcome this resistance either in the inpatient or outpatient setting. Claburn (2004) acknowledges that while some physicians initially resisted the technology, that is now changing. 'There's increasing emphasis on the quality of care, and increasing litigation' (Claburn 2004). Human errors which could possibly be prevented by electronic health systems could wind up costing a hospital a million dollars in a lawsuit (Claburn 2004). Therefore, as previously stated, a strong objective of initiatives such as HealthConnect and the current PCEHR is to encourage early uptake and installation of the system to help realise its benefits sooner rather than later. This study aims to identify those variables with the greatest potential to influence care providers' willingness to adopt SEHRs.

3.5.2.1 Infrastructure Challenges

Shared Electronic Health Record technology has a great potential to save lives as well as money, with the benefits far outweighing the initial implementation costs. However, these potential benefits can only be realised if the various systems in place across the country 'exist', and can 'talk' to each other. While rapidly improving in recent years, one primary factor identified is the lack of technology infrastructure at doctors' offices, especially small practices (Hare 2001; McGee 2004). Implementing this infrastructure comes at a significant cost, particularly to small practices. Secondly, the lack of interoperability between SEHRs has been a major barrier towards the deployment of shared electronic health systems (Schloeffel 2004a). The challenge, therefore, lies in developing a national framework for infrastructure, privacy and security and common standards to support the reliable flow of information across the health sector (Health Connect 2004a). Conrick (2006, p. 12) states that 'The introduction of standards for technology and language will enable greater connectivity and understanding between clinicians while supporting data analysis and audit'.

In order to overcome the challenges of system interoperability, as part of the development of the PCEHR program, e-health lead implementation sites have been established around Australia to deploy components of electronic health record systems, providing valuable learning to inform the implementation of the national PCEHR system (Commonwealth Department of Health and Ageing 2011).

In addition to concerns over the scope of and compatibility between systems, it is also worth emphasizing that the healthcare context differs from other traditional information system applications domains in that SEHR systems often concern sensitive and confidential information, which leads to critical decisions relating to people's lives (or quality of life) (Atkinson et al. 2002). In addition to the cost and connectivity issues, considerable argument exists relating to privacy concerns, from both care providers and consumers against introduction of shared electronic health systems.

3.5.2.2 Care Providers Privacy concerns

Systems of SEHRs have traditionally proved very difficult to design and implement successfully. 'Issues to be overcome include: reassuring care providers and consumers that their privacy will be protected; the need to stick to agreed terminology; the challenges surrounding entering data on the record; providing decision support tools which health care providers value; and ensuring access only to authorized users' (Briggs 2000c, p. 21). Key questions are how much security is enough, who owns the record(s), and who gets to use the data (Commonwealth Department of Health and Ageing 2011; Detmer & Gillings 2000). There are concerns that a system such as the PCEHR system may be used to check doctors' prescribing habits or consumer entitlements like medications at concession rates (Darr et al. 2003; Merkes 2000; Moumtzoglou 2010; Shaw et al. 2011; Tao 2011).

In addition to concerns that SEHRs may be used to check care providers' prescribing habits, the discoverability of data under legal proceedings encourages silence about errors committed or observed. Errors and safety issues can go undetected and unreported, both externally and within health care organisations (Cooper 2007; Kohn 2000; Sheps & Cardiff 2011). Kohn (2000, p. 127) states that the 'Fear of legal discoverability or involvement in the legal process is believed to contribute to underreporting of errors'.

In addition to the concerns raised above, it has been identified that there are also enormous dangers in information overload, especially in diagnosis and treatment contexts (Burgess, Gray & Fiddian 2004; Burke, L. & Weill 2005; Clarke 2001; Farman, Honeyman & Kinirons 2003; Kerr & Norris 2004; Lott 1997; Murray & Lynn 1996). The discussion relating to the amount of information available on the internet alone provides some context to the depth of information – both useful and otherwise, which must be taken into account.

Findings from this study may identify specific variables relating to privacy impacting upon care providers' willingness to adopt SEHRs.

3.5.2.3 Consumer Privacy Concerns

International surveys indicate that the public is particularly anxious about privacy in the context of electronic health related issue. A report by the California HealthCare Foundation found that 67% of the national respondents felt "somewhat" or "very concerned" about the privacy of their personal medical records (Bishop et al. 2005).

As relevant to the PCEHR system as to the context in which the statement was made over a decade ago, as stated in Chapter Two, Neame and Kluge (1999) point out that 'accepting the benefit of technology is easy; offsetting it against risk is harder'. The potential for breaches of confidentiality may render patients less ready to share confidences with doctors and render doctors less likely to record them - both of which are detrimental to good clinical care (Keeley 2000). For example, over 66% of respondents to a survey on electronic health records felt that electronic health records could reduce medical errors. Further, nearly 13% of respondents withhold personal information—such as existing health problems—which could *reduce* errors (Angst & Agarwal 2009).

3.6 Encouraging Adoption of Shared Electronic Health Records

Despite the computer based patient record being 'almost here' for 40 years, it has still not arrived. Its advantages are clear: 'computer based patient records and other systems give physicians and other authorized personnel the ability to access patient data without delay at any time in any place (e.g. in an emergency or when the patient is away from home)' (Kohn 2000, p. 178).

3.6.1 Addressing Privacy Considerations

As identified throughout this chapter, the collection and use of health information has been identified as a cause for public concern in Australia and also within other countries (Adkins et al. 1998; American Psychiatric Association 2008; Bennett 2001; Berner, Detmer & Simborg 2005; Briggs 2000a; Fetter 2009; Mulligan 2001; Princeton Survey Research Associates 1999; Privacy Commissioner 2000). The contribution of computers to health care will be limited by the extent to which users and the community of patients come to trust them to manipulate data and support decisions while protecting their privacy (Naeme & Kluge 1999).

Fetter (2009) states that privacy is commonly viewed as the ability to control information about one's self, such as medical and personal data. Shared electronic health records pose a threat to the need to share information and the right to privacy of care provider's and their patients. Given breaches in data security in banking, retail, social security, and national security, violations of patients' privacy are easy to envision with the potential for wide accessibility to patient records (Fetter 2009).

Over a decade ago, Detmer and Gillings (2000) stated that privacy considerations may well offer the greatest capability to both foster and limit future prospects of electronic health systems. This remains as relevant today as when the statement was made. A study conducted in the United States by Rand Corp. has found that the key to overcoming privacy concerns surrounding the use of SEHRs would come through the creation and enforcement of laws which severely punish those who misuse information retrieved from electronic health records (Information Management Journal 2009).

Regulation is clearly needed and striking the right balance will be a challenge, particularly for that sector of the population who are very concerned about their privacy (Detmer & Gillings 2000). In order to begin to address privacy needs, Kohn (2000, p.178) states that 'uniform standards for connectivity, terminology, and data sharing are critical if the creation and maintenance of health care databases are to be efficient and their information is to be accurate and complete. National standards for the protection of data confidentiality are also needed'.

Dearne (2005b) states that 'All jurisdictions have privacy legislation of one sort or another, and we want to see those laws fully applied to these systems'. A summary of the legislation impacting on the information requirements of the health sector, both at a commonwealth level and a state based level, has been identified in Chapter Two. The implementation of the PCEHR system includes provision for the introduction of a comprehensive legislative framework, including the introduction of the *Personally Controlled Electronic Health Records Bill 2011* (Commonwealth Department of Health and Ageing 2011). The *Personally Controlled Electronic Health Record Bill 2011* establishes the foundations for the Australian Government's PCEHR System which aims to improve the quality, safety and access to health and medical care for consumers, and includes provision for prosecution for a number of issues such as privacy breaches. The *Draft PCEHR Legislative Issues Paper* states that if consumers, healthcare providers and other organisations are to actively participate in the PCEHR system, there must be a high level of trust and confidence in its operation (Commonwealth Department of Health and Ageing 2011). A legislative framework that provides clear, transparent and flexible oversight of the operation of the system as it develops and evolves is required.

In the Office of the Australian Information Commissioner's (OAIC) submission to the Senate Standing Committee on Community Affairs, the OAIC recommends that the protections embedded in the PCEHR System by legislation should apply to all health information within the System including information that was originally obtained from the PCEHR system and later stored elsewhere (Pilgrim 2012).

Further, the submission states that ensuring that privacy is adequately addressed is fundamental to achieving community trust in the PCEHR System, and gaining consumer acceptance and take-up of the System (Pilgrim 2012).

An understanding of privacy concerns and standards enables care providers to advocate for information systems and policies that protect client privacy yet facilitate the benefits of SEHRs (Fetter 2009). Angst and Agarwal (2009) suggest that as SEHRs become more technologically advanced and the challenges of interoperability across facilities are addressed, it is inevitable that issues related to exchanging data across the internet will become more salient. Within the context of the PCEHR, Pilgrim (2012) states that individuals have an interest in clear and consistent privacy protections applying to their health information in the PCEHR system, irrespective of where it is accessed and how it is subsequently stored. This is particularly important given that the PCEHR system will transform the way in which health information is shared across jurisdictions (especially taking into consideration the difference in existing privacy and health laws across Australian states and territories).

Internationally, the European Union, United Kingdom, Canada, and New Zealand are among the governmental entities that have acted to establish privacy rules for personal health information (Connecting for Health, 2008; Euroscap, 2008; New Zealand Medical Association, 1994; Office of the Privacy Commissioner of Canada, 2004).

The development of PCEHR system will consist of a multi layered privacy approach where:

- The privacy concepts to be supported by the PCEHR System align with the National Privacy Principles (NPPs) found in the *Commonwealth Privacy Act 1988*.
- Technical and security measures will ensure accurate authentication of users accessing the PCEHR System, and robust audit trails exist;

- Requirements exist so that healthcare providers and organisations comply with relevant system rules, standards and legal requirements; and
- Educating and training users in the system is carried out.

(National E-Health Transition Authority 2011; Health Connect 2004a, p. 10)

3.7 Applying Diffusion of Innovation Theory to the Adoption of Shared Electronic Health Record

This research examining the implementation of shared electronic health records (SEHRs) utilises Rogers Diffusion of Innovation theory (1995) as a basis for its theoretical framework. Chapter Four details how Rogers' theory has been used to formulate this study's research questions.

Kale and Arditi (2010) state that diffusion of innovation has received significant interest from a wide range of disciplines such as management, economics, marketing, and sociology for more than four decades. This interest has generated a rich literature. Kale and Arditi (2010) conclude that the emergent picture from this literature is that the cumulative adoption of an innovation generally follows a S-shaped curve composed of: 1) an initiation and implementation phase with slow growth; 2) an adoption phase with fast growth; and 3) a saturation phase with decelerating growth (Mahajan et al. 1990).

Innovation diffusion models adopt a conceptual framework for understanding the diffusion of the innovation process (Kale & Arditi 2010). Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers 2003). Diffusion is a communication process in which adopters persuade those who have not yet adopted to adopt (Valente 1995). Subsequently, different research approaches have been set forth in the literature to explain the observed S-shaped curve e.g., Bass 1969, Rogers 1995, Burt 1987, and Moore 1995.

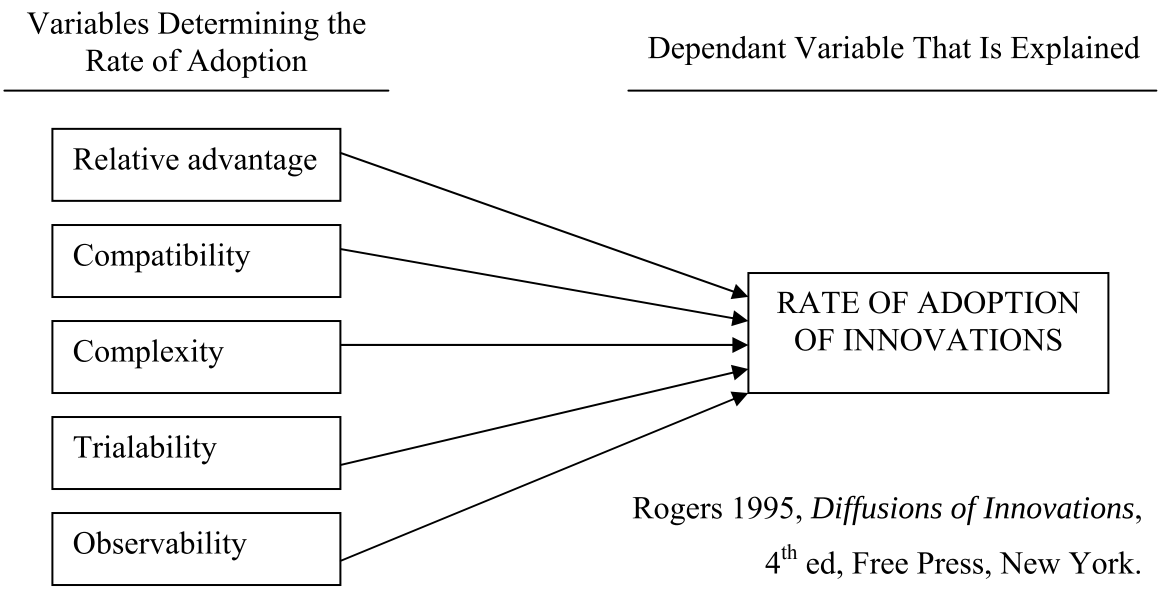
The term innovation refers to ideas, practices or objects that are perceived as new by an individual or other unit of adoptions (Rogers 1995). An innovation diffusion model focuses on describing and explaining the adoption process as a process of innovation diffusion at the aggregate level (Kale & Arditi 2010). The main objective of innovation diffusion models such as those used by Bass (1969) and Rogers (1995) is to explain or predict rates or patterns of innovation adoption over time (Mahajan et al. 1990).

Rogers (1995) states that the characteristics of an innovation, as perceived by individuals, help to explain adoption rates. This is also consistent with other studies, which have found that the attitude of adopters to the various characteristics of an innovation influences adoption rates (Attewell 1992; Darr et al. 2003; Mahajan et al. 1990; Teng et al. 2002). Variables which affect rate of adoption of an innovation, as determined by Rogers (1995), are:

1. relative advantage;
2. compatibility;
3. complexity;
4. trialability; and
5. observability.

Rogers framework of variables determining rate of adoption is illustrated in Figure 3.4 below:

Figure 3.4 Rogers Framework of Variables



Rogers 1995, *Diffusions of Innovations*, 4th ed, Free Press, New York.

Once the factors identified by Rogers were applied to the research, some adaptation to the theoretical framework was required in order to ensure relevance to the subject matter – adoption of SEHRs. In the context of this study, care providers' willingness to adopt SEHRs is measured. Section 3.7.1 below outlines the rationale for focusing on care providers' willingness to adopt as opposed to measuring rate of adoption of SEHRs.

3.7.1 Predicting willingness to adopt

The timing of this research is such that, at this point, SEHR use by care providers is not at a stage of diffusion where it is feasible to assess actual adoption behaviours. Similar to a study conducted by Angst and Agarwal (2009), for the most part, there are few cases in which SEHRs are stored in interoperable systems or made available via the internet to care providers or patients. Further to this, a study by Peterson et al. (2009) found that in America, the percentage of physicians using 'fully functional' electronic health record systems (e.g. incorporating extensive clinical features) only grew from three to four percent between 2006 and 2008.

Therefore, as yet, while care providers typically have not adopted the technology; they can form attitudes and beliefs about the concept of participating in adoption of SEHRs. Therefore use must be assessed through perceptual measures rather than actual opt-in behaviour. Consequently, this research will ascertain whether care providers would choose to opt-in to an SEHR system if they are given the choice in the near future. Therefore, the variable—*willingness to adopt* — is integrated into the innovation model as a means of estimating actual future behaviour.

As an additional factor impacting care providers willingness to adopt, due to the nature of implementation of Government initiatives such as that of HealthConnect or PCEHRs – the basis for a national framework of SEHRs - these projects by nature have a *mandatory* adoption procedure. Adoption of SEHRs is therefore unlike other innovations where individuals can *choose* whether to implement or not based on Rogers' variables identified above. For mandatory implementation, as the term suggests, adoption will result in *all* relevant people within the specified community adopting the innovation. Measuring rate of adoption would then become irrelevant because eventually, all members in the specified community will have to adopt the innovation. As outlined above, what may be highly variable however is adopters' *willingness to adopt.*

Willingness to adopt may impact strongly on the cost and length of the implementation process. Information provided in this Chapter has identified that the widespread clinical use of SEHRs amongst care providers is currently in its infancy. In order to promote acceptance across all care providers, considerable effort needs to be made to identify those factors which may affect willingness to adopt. By identifying those factors that have a positive or negative impact upon willingness to adopt an innovation, the effectiveness of the implementation program may be improved. This study therefore focuses upon the factors impacting upon *willingness* to adopt an innovation.

Research to ascertain willingness to adopt an innovation will invariably require some adaptation to the variables Rogers presented for measuring rate of adoption. The first variable Rogers identified as affecting an innovation's rate of adoption is relative advantage. Relative advantage gauges the degree of advantage gained from implementation of an innovation, compared to the previous system/s used. If an innovation has a perceived advantage or disadvantage over what it is designed to replace, those adopting the innovation will be either more, or less willing to adopt based on the degree of advantage the new innovation has. For example, if an innovation produces a cost saving to an organisation of 10 percent, those adopting would be more *willing*. Therefore, relative advantage can still be considered an important variable which may impact upon willingness to adopt SEHRs.

Compatibility is the second variable used by Rogers to analyse rate of adoption. As outlined by Rogers, compatibility can be viewed in terms of being consistent with existing values and procedures. Compatibility in relation to the current study can be viewed from a number of perspectives. Firstly, compatibility may be viewed from the perspective of technology usage. Those who indicated that they have a high level of technology usage may be likely to have positive attitudes towards technology, and be more likely to find SEHRs more compatible with current systems. Consequently, based on positive compatibility, care providers may be more willing to adopt. Additionally, compatibility can potentially challenge existing values. If innovations challenge deeply embedded work patterns or subcultures, care providers may be reluctant to make the innovation part of their work routines (Buell 2009; Darr et al. 2003; Reid 2010; Wu et al. 2010). Effective communication can enable or disable the adaptiveness needed to navigate change successfully (More & McGrath 2002). Therefore, compatibility with existing values or procedures could be considered relevant in influencing a care provider's willingness to adopt SEHRs.

The third variable identified by Rogers as affecting rate of adoption is complexity. Again, like relative advantage and compatibility, complexity is a factor which could impact upon an individual's willingness to adopt. For example, if a system of

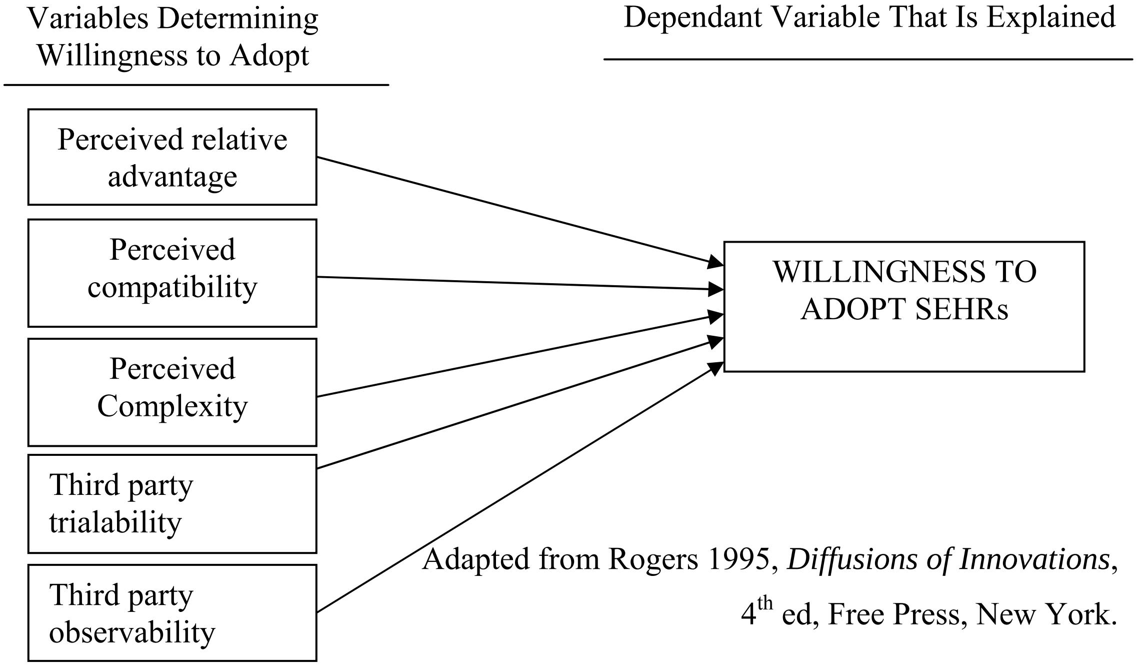
SEHRs is perceived to pose complexities in terms of: (a) meeting regulatory and legal requirements; or (b) technical difficulties, care providers may be less willing to adopt the new system (Wu et al. 2010).

The fourth variable which Rogers presents as impacting upon rate of adoption is trialability. The notion of trialability refers to the ability to trial an innovation before making the eventual decision to implement or not to implement an innovation. However, in the case of mandatory implementation, individuals have no individual ability to trial an innovation and then choose whether to adopt or not. Therefore, trialability could be considered as not directly influencing an individual's willingness to adopt. However SEHRs, as explored earlier in this chapter, have been trialled in the national SEHR initiative of HealthConnect and other smaller pockets within individual states of Australia. These trials have taken place over the past several years, with the aim of ensuring the system runs reliably and can be efficiently implemented nation wide. Therefore, those not involved in the HealthConnect or PCEHR trials have the capacity to learn about the results of the trials, and analyse feedback from those participating in trials. Therefore, while individuals themselves cannot trial SEHRs, they do have the capacity to analyse results of trials conducted by the Government. The results of these official trials may therefore either positively or negatively, influence care providers' willingness to adopt SEHRs. Figure 3.4 will be used to illustrate that the influence of trialability in the context of this study, while not directly potentially influencing willingness to adopt, can from an outside, or from a 'third party' context, be considered to have the potential to affect willingness to adopt.

Observability is the final variable which Rogers uses to measure rate of adoption of an innovation. Observability relates to those involved in the adoption process being able to observe the results of an innovation. Observability in this study is similar in nature to the previous variable, trialability. While an individual cannot observe the results of a trial of SEHRs in their own organisation before deciding to adopt, they have the capacity to observe the results gained from official trials. In the context of this study, as with trialability, while observability may influence care providers' willingness to adopt from a third party point of view, it is not specifically tested in this study.

Based on the above discussion Figure 3.5 (below) illustrates those variables deemed to have the potential to influence willingness to adopt an innovation, as adapted from Rogers (1995) framework:

Figure 3.5 Rogers Framework of Variables Influencing Willingness to Adopt SEHRs



Adapted from Rogers 1995, *Diffusions of Innovations*, 4th ed, Free Press, New York.

Determining the factors which have the greatest potential for influencing willingness to adopt innovations would be considered highly desirably. In the case of this study, the innovation is SEHRs. The desirability of being able to identify factors likely to impact upon willingness to adopt could have significant potential for policy makers, both within and beyond the concept of SEHRs. By targeting those factors which may influence willingness to adopt, the adoption process can become a more efficient, streamlined process which meets the demands of the adopters'. The current study investigates the effects of the first three variables outlined in Figure 3.5, specifically targeting care providers' perceptions of relative advantage compatibility and complexity. Supporting the focus upon relative advantage, compatibility and complexity, Carter and Bellanger (2005) state that after an extensive literature review, Tornatzky and Klein (1982) conclude that relative advantage, compatibility and complexity are the most relevant characteristics to adoption research. Teng et al. (2002) supports this position by stating that the most important characteristics which influence adoption of technological innovations (e.g. SEHRs) are: relative advantage, compatibility and complexity.

3.8 Conclusion

This chapter has provided an in depth examination of technology in health care. The background to the SEHR was initially provided. This found that the SEHR is not a new innovation, with the origins of the technology dating back over 40 years.

The benefits associated with electronic health systems in general, then specifically related to SEHRs, were outlined. These benefits included the potential to improve efficiency and increase the quality of patient care through reduction of medical errors; more accurate records; and improved legibility and presentation of patient records.

The chapter studied the history of Australian initiatives in SEHRs. Across Australia, many programs have been undertaken relating to e-health. Recent Australian initiatives include HealthConnect and PCEHR. The HealthConnect initiative was a partnership between the Australian, State and Territory Governments, aiming to improve safety and quality in health care by facilitating the establishment of a range of standards based products and services that will enable the secure exchange of information between health care providers and consumers. The current PCEHR follows on from the HealthConnect initiative, and is a $466.7 million investment which will allow Australians to check their medical history online through the introduction of personally controlled electronic health records, which will boost patient safety, improve health care delivery, and cut waste and duplication (Commonwealth Department of Health and Ageing 2010b).

The chapter explored the rationale as to why despite the fact that computer based patient records had been in existence for over 40 years, they had not been previously adopted on a larger scale. Specific causes identified included concerns from both care providers' and patients surrounding privacy of the records, lack of a common technological infrastructure to support a national network, and the legislative environment.

Finally, the theoretical framework for this study was then introduced – Rogers Diffusion of Innovation Theory. The variables comprising Rogers' theory were provided, and were then outlined in the context of this research.

In the next chapter, the methodology for this study is detailed. Issues to be discussed include a consideration of the research design, the sampling strategy, data collection methods, data analysis and reporting of findings.

CHAPTER 4 – RESEARCH DESIGN AND METHODOLOGY

The literature review chapters of this thesis have provided an overview of issues of compliance governing the use of information in the health sector, and discussed the evolution of the electronic health record. This chapter will look in greater detail at Rogers Diffusion of Innovation theory and Davis' Technology Acceptance Model, and the relationship between these theories and the electronic health record. Based on the literature review, this section discusses the methodology for the study, considering the research design, the sampling strategy, data collection methods, data analysis and reporting of findings.

4.1 Secondary data

Secondary data from journals, relevant texts, electronic and working paper sources concerning several topics including information management practices, diffusion of innovation theory, recordkeeping systems, and compliance with regulation and legislation within the health industry worldwide provide a conceptual and theoretical foundation for the study. An intensive literature review was conducted to gather evidence that would link willingness to adopt SEHRs with care providers' perceptions of relative advantage, compatibility, and complexity which overshadow the health industry. An analysis of the secondary data provided the means of establishing the research question, objectives and hypotheses to be investigated.

4.2 Primary data

To gain a deeper understanding of the issues involved and to explore the research questions fully, the research question was tested using primary data. The quantitative phase of the research involved a self administered questionnaires involving all active Australian Medical Association Queensland (AMAQ) registered health care providers from the public and private sector (Appendix A). The goal of the questionnaire was to identify from a care providers' perspective, factors which have the most significant impact upon willingness to adopt SEHRs, based on the factors identified by Rogers as most relevant to this study – relative advantage, compatibility and complexity. Care providers' perspectives would also be able to be used to determine whether factors which comprise the Technology Acceptance Model (TAM) influenced willingness to adopt.

4.2.1 Survey Methodology

McPhail (2003) states that survey research is a primary data collection method where information is collected verbally or through written response. The primary purpose of survey research is to describe some phenomenon. In order to identify possible factors identified by care providers' as influencing willingness to adopt SEHRs, the quantitative phase of the research involved a self administered questionnaire issued to public and private sector care providers registered with the AMAQ. The questionnaire method was chosen because it is one which has been used previously in health studies, and is shown to be appropriate for the current type of analysis (Pierce 2004)

The decision to employ a survey technique for the current study was a deliberate choice made because of the advantages a survey technique provides over other methods such as interviews and observations. While a survey relies on the cooperation of respondents to complete the questionnaire and to provide meaningful and accurate information, according to McPhail (2003), the strength of the survey technique is its versatility and rapid data collection. The survey instrument can be distributed and data collected in a number of ways which can be adapted to fit the particular circumstances. Surveying using mail as a medium of communication can expand the geographical coverage, thereby reducing time and cost involved compared to other alternative methods such as face-to-face interviewing or observation (McPhail 2003). Specifically relating to this study, cost and time restraints proved to be a major determinant in choosing the questionnaire format.

Literature review findings, together with information gained from discussions with members of the AMAQ, were used as a basis for the construction of a mail survey of all active members of the AMAQ. The questionnaire also contained a number of demographic and situational variables considered necessary to the hypothesis testing

The questionnaire was provided to AMAQ staff for evaluation and discussion to ensure suitability of questions to the target population.

4.3 Sampling process

4.3.1 Target population

The population used for this research was all currently active Health care providers registered with the AMAQ. This population consisted of approximately 5013 members, located throughout Queensland. The roles of these care providers' could be broken down into the following categories: Specialists; General Practitioners; Residents; Registrars; Salaried Specialists and Senior Medical Officers. These members were assumed to have some degree of awareness of SEHRs. AMAQ member knowledge of SEHRs may have possibly been gained from potential involvement in trials of the HealthConnect system, interaction with colleagues involved with HealthConnect, and/or as a result of extensive levels of regulation developed for each of the respective states (Briggs 2000; Legal Information Access Centre 2001; Australian Government 2004; Allens Arthur Robinson 2004; Health Connect 2004; Parker, Hewitt, & McWilliam, 2004; Privacy NSW 2004).

4.3.2 Sampling frame

It was anticipated that respondents would cover each of the three different levels of the health care social system, as referred to in section 3.0. It was determined that the entire population of 5013 active AMAQ registered care providers would be used rather than a sample of this population. While a sampling frame of 5013 could seem excessive, members associated with the AMAQ explained that the typical response rate based upon results of previous surveys conducted from this population is at best, 5%. This is due to the extremely busy nature of work that members of the health community are constantly involved in.

4.3.3 Distribution

Data was collected through a mail survey sent to all active members of the AMAQ. The survey was distributed by the AMAQ mail house, but returned directly to USQ to protect confidentiality of AMAQ members.

4.4 Survey Design

Ideally interviews would have been carried out, but this was not possible owing to budget, time and geographic constraints. As previously outlined, the survey was mailed out by the AMAQ mail house, to ensure confidentiality of members. Responses were then sent directly to the USQ for data analysis.

The questionnaire was organized into the following five themes:

- Part A – Demographics
- Part B – Technology
- Part C – Patient Care
- Part D – Legislation
- Part E – Shared Electronic Health Records

These themes cover the many facets of SEHRs, and provide data about the perceived factors which influence care providers' willingness to adopt SEHRs. Questions relating to demographic detail were added in order to assist in data collection and to form the basis of comparisons across business sectors and regional differences.

A number of methods were used in the survey design to assist in building the response rate. In order to increase the response rate, Mozian (2003) suggests that a covering letter should be attached to the survey. Nicastro (1999) states that the covering letter should provide details relating to who should complete the questionnaire. The covering letter attached to the survey can be found in Appendix B. It was felt to be important that the covering letter illustrated the importance of the use of technology to facilitate the management, and sharing of information in order to aid efficient patient care. Zikmund (2003) additionally suggests that the covering letter should explain that the questions are simple and to the point, and that a follow up email or letter to remind the respondent to complete the survey would be sent.

4.5 Scale of measurement

The questionnaire consisted of nominal, ordinal and interval scales, to facilitate tests such as Chi-Square analysis to more detailed tests such as Categorical Principal Component Analysis (CATCPA) and regression. Data from the questionnaire could also be utilised in future research studies and to conduct correlation analysis and gap analysis.

The questionnaire was designed to provide data suitable for CATPCA and regression analysis. The goal of CATPCA is to reduce an original set of variables into a smaller set of uncorrelated components that represent most of the information found in the original variables. In addition, and of importance for this study, CATPCA allows analysis of complicated multivariate data, consisting of nominal, ordinal and numerical variables (Meulman et al. 2004), and is therefore suited for variables of mixed measurement level that may not be linearly related to each other (Manisera et al. 2010). Further, this technique is most useful for extracting relevant information from large data sets, where a large number of variables prohibits effective interpretation of the relationships between objects (IBM 2011; Meulman et al. 2001; Shlens 2009). Because of these characteristics, CATPCA is a powerful technique to explore patterns in data (respondents, groups, and variables).

Hair et al (1998, p. 14) defines multiple regression as ‘the appropriate method of analysis when the research problem involves a single metric dependent variable presumed to be related to two or more metric independent variables’. In addition to the definition provided by Hair et al, Zikmund (2003, p. 576) states that multiple regression analysis is ‘an analysis of association in which the effects of two or more independent variables on a single, interval scaled or ratio scaled dependant variable are investigated simultaneously’.

The combination of use of CATPCA and multiple regression is supported by Agarwal & Rao (2011) and Muelman et al (2004, p.53) who state that ‘CATPCA can be used as a pre-step in multiple regression analysis when the number of predictors exceeds the number of objects’. This methodology is followed in this study due to the number of variables that could potentially influence Relative advantage, Compatibility and Complexity (refer sections 4.7.1 – 4.7.3).

Where as CATPCA is non parametric (Shlens 2009), based on the definitions of multiple regression, it can be seen that metric data in an interval, or ratio scale format is required to undertake the analysis. Figure 4.1 provides an example of the type of questions asked in the questionnaire, which will be examined using regression analysis and other statistical analysis techniques.

Figure 4.1 **Example of 5 point Likert scale Question**

	Extremely willing	*Very willing*	*Somewhat willing*	*Some concerns*	*Extremely against*
How would you rate your willingness to adopt a SEHR system at some time in the future?	☐$_5$	☐$_4$	☐$_3$	☐$_2$	☐$_1$

Figure 4.1 illustrates an example of a 5-point Likert scale which was used as a basis for providing the interval scale data as required for regression analysis. Zikmund (2003, p. 298) defines interval scales as ‘a scale that not only arranges objects or alternatives according to their magnitudes, but also distinguishes this ordered arrangement in units of equal intervals’. This definition is used as a basis to illustrate that the use of 5-point Likert scales is suitable for obtaining and providing the ability for analysis of interval scaled data.

In addition, testing of the hypotheses will also employ the use of Chi-Square analysis. The Chi-square test is used to test if a sample of data came from a population with a specific distribution, in other words, it is used to examine the strength of the association between collected data and the specified distribution. The p-value is the probability of observing a Chi-square statistic at least as large as the one actually observed, given that there is no association between a variable of data occurring by chance (Hair et al 1998, p.549; Zikmund 2003, p.522).

In addition, the questionnaire is structured in such a way to facilitate future testing of the data through use of correlation analysis and gap analysis. With many questions seeking data relating to ‘expected outcomes’ and ‘actual outcomes’, future statistical analysis to analyse significant variance is facilitated.

4.6 Theory Used to Formulate Research Model

The current study deals with investigating the factors which potentially influence willingness to adopt shared electronic health records (SEHRs). One of the primary aims of SEHRs is to improve patient care. In order to successfully implement SEHRs, two primary processes must be undertaken. The first process identified is the development of a standardised SEHR and accompanying systems, which will meet the needs of care providers. The second process which is the topic of this research study is for care providers to be convinced to adopt.

These processes relate closely to Rogers' diffusion of innovation (DOI) theory which will be used as a framework for discussion and analysis. Diffusion of Innovation theory is used because it is well established and widely used in information technology diffusion related research (Prescott & Conger 1995).

An innovation is defined as 'an idea, practice, or object that is perceived as new by an individual or other unit of adoption' (Rogers 1995, p. 11). The concept of the SEHR is analysed in this study as the innovation. Several authors have identified that IT applications, such as electronic health records, are consistent with the definition of an innovation (Burke & Menachemi 2004; Carter & Belanger 2005; Levine 1994; McMaster & Wastell 2005). As is explored in Chapter Three of this thesis, the concept of the electronic health record is not one which is new. The concept has been around for 40 or more years (Schloeffel 2004). 'Newness' of a product in terms of being something state of the art and never thought of before is not a requirement for DOI theory. Rogers states that 'someone may have known about an innovation for some time, but not yet adopted or rejected it. "Newness" of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt' (Rogers 1995, p. 11). What is 'new' about the current innovation is the concept of 'sharing'. Previous health record systems have not had the push towards sharing electronic records across an entire system to appropriate health care providers.

In addition to the development of an innovation, a key aspect of the DOI process is the actual diffusion of the product. Rogers (1995, p. 5) defines the diffusion procedure as ‘the process by which an innovation is communicated through certain channels over time among members of a social system. It is a special type of communication, in that the messages are concerned with new ideas’. Once again, in the context of the current study, the communication which is taking place and outlined in section 4.3 of the research is the push towards implementation of a nation wide electronic health system. In Australia, this push is being driven by the Australian Government, utilising the concept of SEHRs. One of the primary aims of the diffusion is to detail how the innovation will amongst other things, improve patient care.

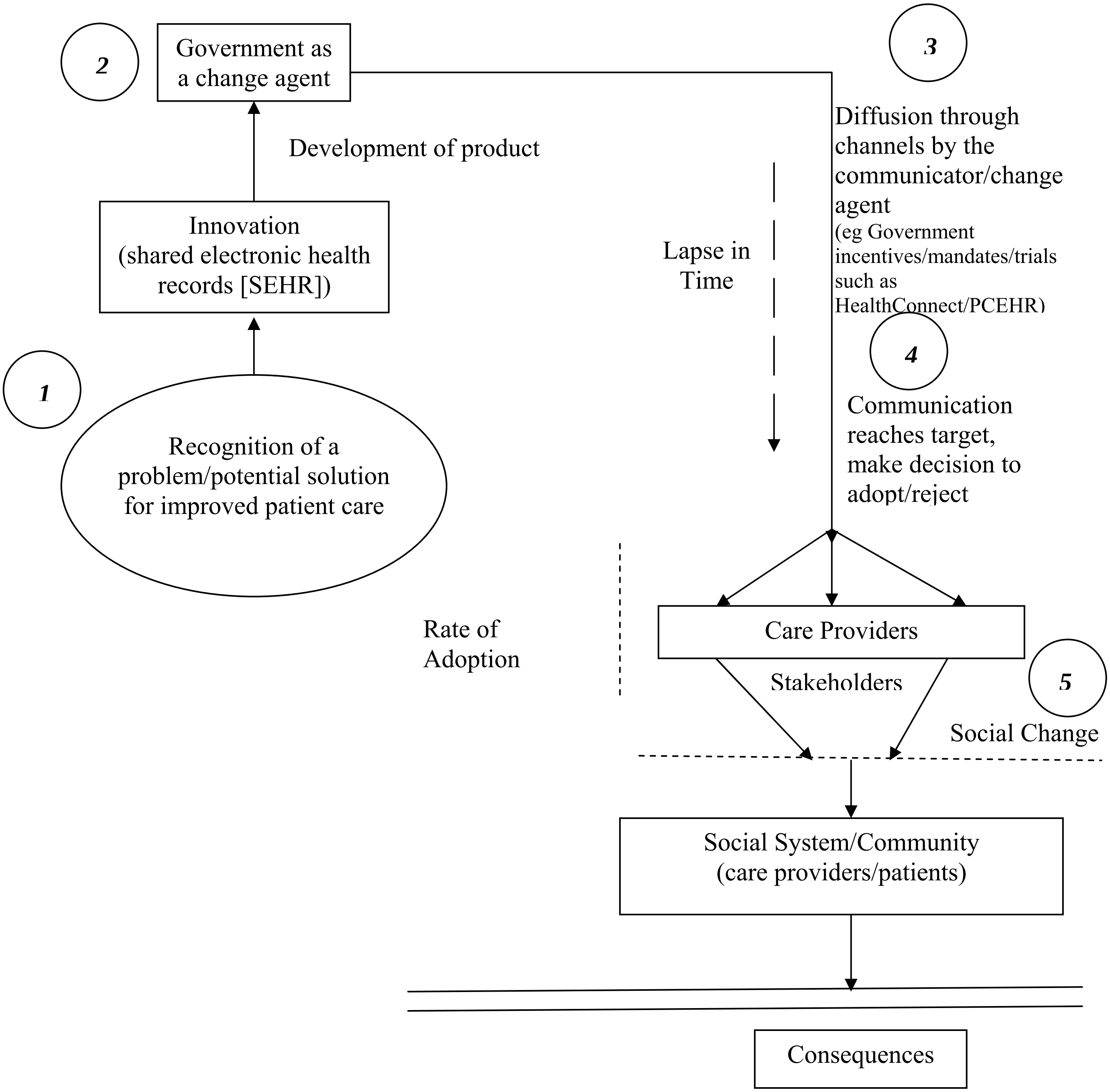
A further characteristic of diffusion of innovation theory is that the newness of the product being communicated means that there will often be some degree of uncertainty involved in the diffusion (Rogers 1995). Therefore, it is essential in the communication phase of the new idea or innovation, that as much information is presented and available as possible, in order to alleviate any unpredictability and uncertainty that may exist. Section 4.3.3 of the study outlines some of the steps taken in this case by the Government, in order to communicate and develop an electronic health system which will lead to the highest possible rate of adoption.

One of the primary measures of the diffusion of innovation theory is the rate of adoption of an innovation. An innovation’s rate of adoption can be defined as ‘the relative speed with which an innovation is adopted by members of a social system. It is generally measured as the number of individuals who adopt a new idea in a specified period, such as each year’ (Rogers 1995, p. 206). The current study focuses on and extends on the relevant variables outlined in Rogers (1995) diffusion of innovation theory – Relative advantage, Compatibility and Complexity, to investigate care providers’ *willingness* to adopt SEHRs.

Innovations may be implemented into a social system in different ways. Rogers (1995) uses the term ‘innovation-decision’ to describe this process. Rogers provides a number of different methods in which ‘innovation-decisions’ can be made. These include optional innovation decision; collective innovation decision; and authority innovation decision (Rogers 1995, p.28).

Systems such as HealthConnect and the PCEHR system (discussed in more detail in Chapter Three) which are based on SEHR technology have the possibility of mandatory implementation. This is a type of authority decision typically mandated by Governments. Mandatory adoption would not necessarily take into account Rogers (1995) variables which impact upon rate of adoption. Instead, using these variables to determine *acceptance* of an innovation, they could be used to identify *willingness* to adopt, and to identify those factors which have the greatest impact upon individuals’, or organisations’ decision to accept change. This could ultimately lead to Governments’ targeting a specific attribute of an innovation, leading to quicker acceptance of change, resulting in reduced time, money and effort in attempting to gain acceptance of a product/policy. The aim of the research is therefore to try to identify possible factors, such as potential legislative complexities relating to compliance, or probable advantages gained upon the introduction of SEHRs, which affect an innovation’s rate of adoption. The adaptation of Rogers’ DOI theory to SEHRs as outlined in this chapter is illustrated in Figure 4.2.

Figure 4.2 Diffusion of Innovation Process for Shared Electronic Health Records



Adapted from Rogers 1995, *Diffusions of Innovations*, 4th ed, Free Press, New York

The relationship between SEHRs and the adaptation of DOI theory is explored in Figure 4.2. The first phase of the theory is the realisation of a need for improvement in the current system of patient records. A SEHR system is identified as a way in which improved patient care can be achieved.

Secondly, in the case of SEHRs, because of the need for the system to be compatible nation wide, the Government is the change agent involved in the development and implementation of SEHRs. Thirdly, the change agent diffuses their innovation through initially outlining to the medical community the benefits of a nation wide electronic health system then through implementing trials of SEHRs (HealthConnect/PCEHR system), to finally providing incentives or issuing mandates for the adoption of the system. Fourthly, traditionally the target market for an innovation then makes the decision to adopt or reject. Often, there can be a considerable lapse in time before the decision is made. This lapse in time is referred to as the rate of adoption. However, SEHRs are likely to have mandatory implementation. Therefore, the ability to be able to identify factors which influence *willingness* to adopt can be crucial to ease concerns which care providers' may have over mandatory adoption, and therefore increase their willingness to adopt SEHRs. Fifthly, upon adoption or rejection of the innovation by care providers (target market), there may be a social change. For example, through the widespread adoption of SEHRs, the level of health care for the community would likely be improved.

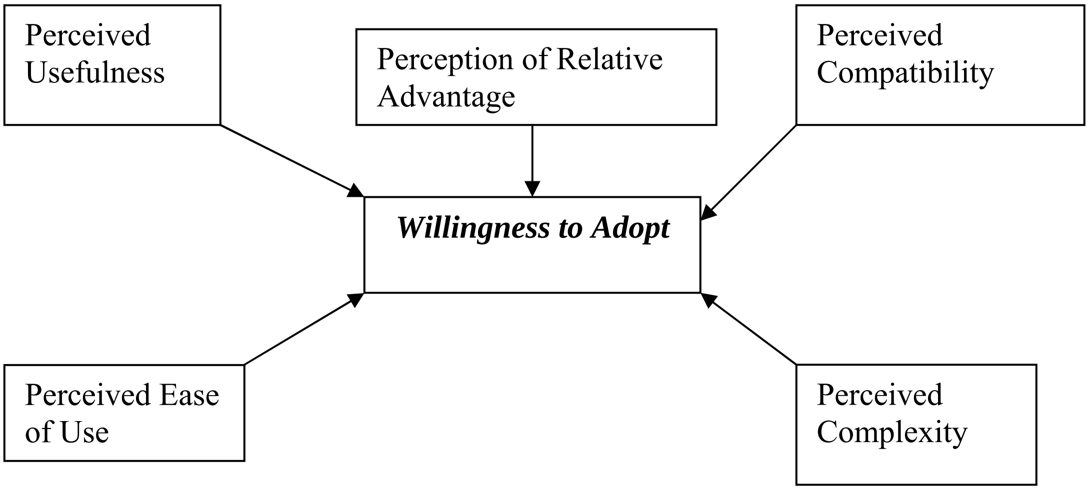
Rogers (1995) states that the characteristics of an innovation, as perceived by the members of a social system, will determine its rate of adoption. Within the current research, the social system comprises care providers involved within the medical fraternity. The medical fraternity can be divided into three broad levels. The first level identified is that of the General Practitioner. The second level comprises that of the Specialist, typically consisting of more specific qualities. The final level identified is that of the hospital, comprising elements such as the emergency room etc. Each of the three above mentioned levels will require an electronic health system to perform different actions. For example, those involved in the first level of the medical fraternity will not require as detailed functions as those required by members of the third level of the medical fraternity. Therefore, the characteristics of an innovation, as perceived by the members of the medical fraternity, will need to incorporate the varying requirements of its many users. Those involved in the development of innovations need to be aware that a very divergent group of users (as previously identified) will be affected by the implementation of an innovation (Darr et al. 2003). Therefore, reactions to a particular innovation such as SEHRs, will vary widely among users. Darr et al (2003) states that identifying the divergent concerns and attitudes of care providers, and designing needs to suit each group, can help innovations to appeal to distinctive groups. In addition to Darr et al, Gagnon et al (2005) state that considering the specific needs of the various healthcare organisations and the various levels of the medical fraternity identified previously, is central for the diffusion of SEHRs to be successful. The communication stage is a vital component of the entire diffusion process. Darr et al (2003) state that health professionals are likely to react positively to innovations that help them accomplish their work and provide other personal or collective benefits. This is an obvious relative advantage, as discussed in more detail in Chapter Three, which covers all spectrums of the medical fraternity, which therefore should be communicated strongly. Overall, More and McGrath (2002) state that key problems with diffusion of innovations reside in the poor selling of change through inappropriate communication, and in not dealing effectively with key users needs, expectations, and fears.

4.7 Hypothesis Testing

Once the survey had been returned from respondents, the data was checked for completeness, and then input into the Statistical Package for Social Sciences (SPSS). Data was checked for accuracy by running frequency distributions and any out of range values were checked. Data was entered into SPSS in order to test the hypotheses listed in sections 4.7.1 – 4.7.6.

The data was analysed primarily by use of CATPCA, regression and Chi-Square analysis to determine relationships, if any, between several concepts, as outlined by the hypotheses to be tested – e.g. the relationship between perceptions of relative advantage and care providers' future willingness to adopt SEHRs. Through use of CATPCA and regression analysis, the relationship between independent and dependent variables can be analysed. In this study, the dependant variable is future willingness to adopt SEHRs. The independent variables which will be examined comprise a number of variables which make up the factors outlined by Rogers' and Davis in section 4.6. The variables used in this study from Rogers' (1995) DOI theory which have the potential to impact upon care providers' willingness to adopt SEHRs are: (a) the perception of relative advantage, (b) perceived compatibility with existing values and (c) perceived complexity, as illustrated in Figure 4.3[1].

Figure 4.3 Variables potentially impacting upon care providers' willingness to adopt



Adapted from Rogers (1995); and Davis (1989)

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[1] Rogers' DOI theory also identifies third party trialability and third party observability as variables influencing the adoption of innovations. As described in Chapter Three, these variables have not been included in the context of this study, given the mandatory nature of innovation of SEHRs.

Additional factors identified by the TAMs model as impacting upon willingness to adopt were perceived usefulness and perceived ease of use (Davis 1989).

4.7.1 Hypothesis One

The first relationship that will be examined will be whether perceived relative advantage has influenced willingness to adopt SEHRs. As outlined in section 2.0, the first hypothesis is:
H_1: That perceptions of the variables comprising relative advantage have the potential to influence willingness to adopt shared electronic health records.

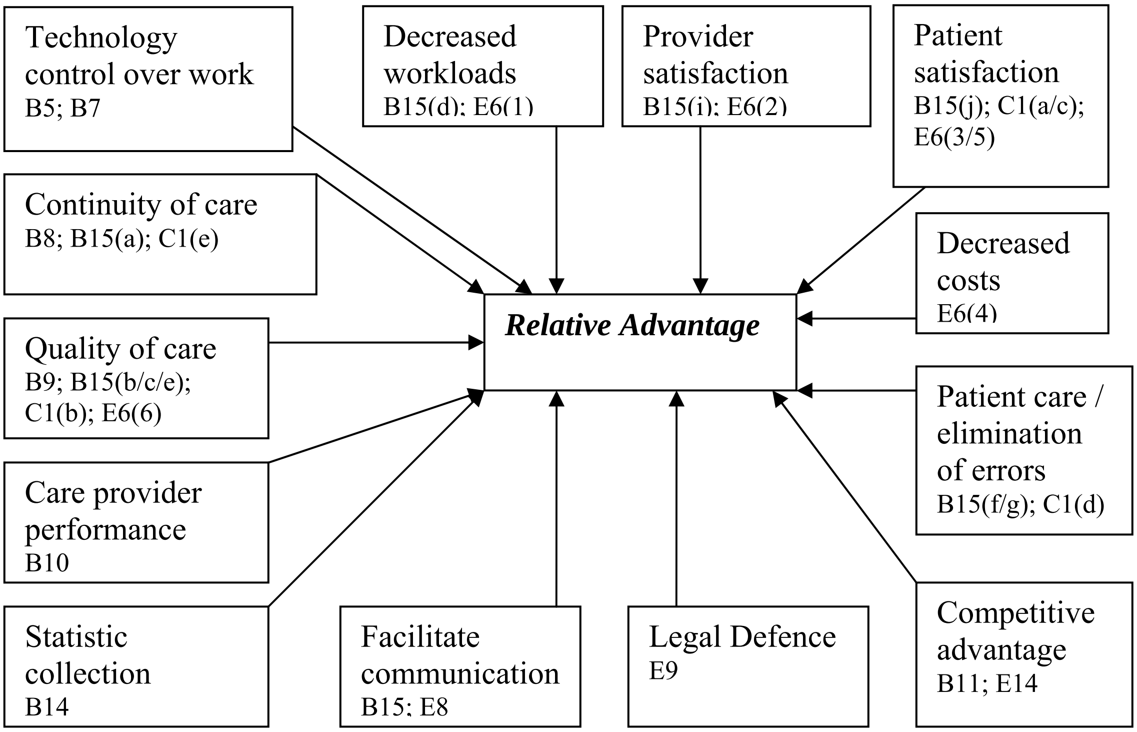
The theory which this hypothesis is based upon is Rogers' Diffusion of Innovation theory (DOI), and the first factor which impacts willingness to adopt – relative advantage. Table 4.1 and Figure 4.4 outlines the relevant variables which will be used to test hypothesis one.

Table 4.1 Relative advantage and willingness to adopt

Questionnaire:

Relative Advantage	B5; B7 – B11; B14, B15 (a - j); C1 (a - e); E6 (1 - 6); E8; E9; E14

Figure 4.4 Factors comprising Relative advantage



Relative advantage is considered to play a key role in enhancing the rate of innovation, and can be defined as the degree to which a new product (i.e. SEHRs) is superior to an existing one (e.g. fragmented information systems, manual paper based methods); a major determinant of the rate of adoption of a new product (Alkhateeb & Doucette 2009; Hashem & Tann 2007; Monash Marketing Dictionary 2009). This is consistent with Rogers (1995) outline of Relative Advantage in his framework of variables determining rate of adoption (Section 3.3.2). Examples of questions found in the survey which were used to identify areas of relative advantage relating to technology and to SEHRs include question B8 – improved continuity of care; and question $E6_1$ – decreased workloads.

Testing methods for H_1 will be undertaken in two stages. The first stage of testing for H_1 will identify which variables from Table 4.1 and Figure 4.4 have the greatest influence on Relative advantage through the use of CATPCA. The variables which are identified as having the greatest influence will then be tested for statistical significance through multiple regression analysis with the single dependent variable from the questionnaire ‘future willingness to adopt SEHRs’. In addition, further analysis will be used to identify which dimension of Relative advantage contains the greatest statistically significant influence on care providers’ future willingness to adopt SEHRs.

4.7.2 Hypothesis Two

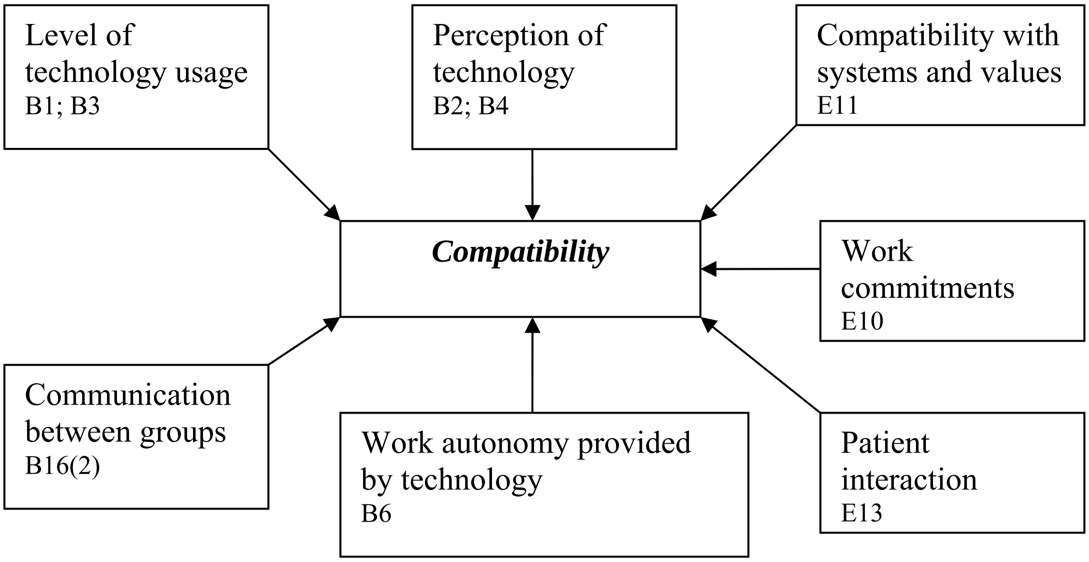
The second hypothesis to be tested will analyse the impact of various factors of compatibility upon care providers’ willingness to adopt SEHRs. The second hypothesis is stated as:
H_2: That perceptions of the variables comprising compatibility with existing systems and practices have the potential to influence willingness to adopt shared electronic health records.

This hypothesis is based upon the second factor of Rogers’ DOI theory which investigates the relationship between the variables comprising compatibility with existing systems and practices and willingness to adopt. Table 4.2 and Figure 4.5 outlines the relevant variables drawn from the questionnaire which will be used to test hypothesis two.

Table 4.2 Compatibility and Willingness to Adopt

Compatibility	B1 – B3; B4(2/3); B6; B16(2) (a- e); E10; E11; E13

Figure 4.5 Variables comprising compatibility



Compatibility can be defined as the extent to which a new product (i.e. SEHRs) requires consumers to adjust to unfamiliar methods of use; a major determinant of the rate of new product adoption, and refers to 'goodness-of-fit' between an innovation and the adopter's needs (Hashem & Tann 2007; Kim & Srivastava 1998; Monash Marketing Dictionary 2009). This is consistent with Rogers' (1995) outline of compatibility in his framework of variables determining rate of adoption (Section 3.3.2).

B4 – perceptions of technology; and E11 – compatibility with existing systems and values, are examples of questions from the survey which are used to measure the level of compatibility between SEHRs and levels of technology usage and current systems and practices related to patient care.

As for H_1, testing methods for H_2 will be undertaken in two stages. Categorical Principal Component analysis will be used to initially identify the component structure of the variables comprising Compatibility, and to identify those variables which have the greatest potential to influence willingness to adopt (from those identified in Table 4.2 and Figure 4.5).

Multiple regression analysis will then assess the relationship between the dimensions of Compatibility and the single dependent variable from the questionnaire ‘future willingness to adopt SEHRs’. This will indicate whether perceptions of compatibility have the potential to influence care providers’ future willingness to adopt SEHRs. As with the analysis used for H_1, the dimension of Compatibility that has the most statistically significant influence on care providers’ willingness to adopt will be identified.

4.7.3 Hypothesis Three

The third hypothesis investigates whether care providers have indicated that potential complexity has impacted upon willingness to adopt SEHRs. The third hypothesis is outlined below:

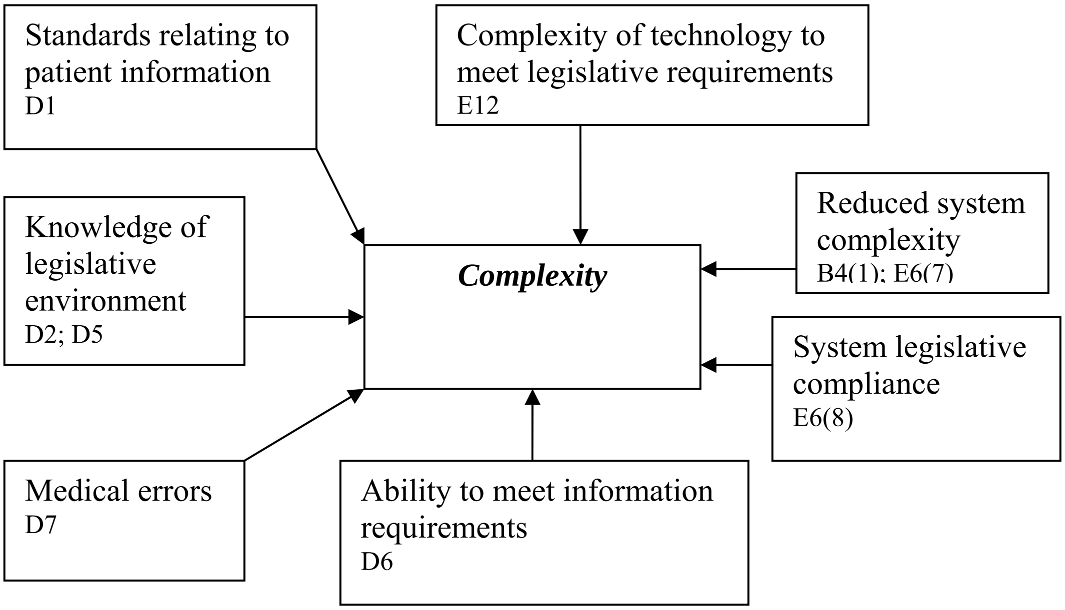
H_3*: That perceptions of the variables comprising complexity have the potential to influence willingness to adopt shared electronic health records.*

This hypothesis is based on Rogers’ DOI theory and the third factor which potentially impacts willingness to adopt – complexity. Table 4.3 and Figure 4.6 outlines the relevant variables which will be used to test how the variables comprising complexity impacts willingness to adopt.

Table 4.3 Complexity and Willingness to Adopt

Complexity	B4(1); D1; D2; D5 (a - c); D6 (a - d); D7; E6(7/8); E12

Figure 4.6 Variables comprising complexity



In the context of this study, complexity can be defined as the degree of difficulty which a user of a new product (i.e. SEHRs) has in understanding the innovation, and the amount of complexity of the environment in which the innovation (i.e. SEHR) will operate (Alkhateeb & Doucette 2009; Hashem & Tann 2007; Monash Marketing Dictionary 2009). Innovation complexity produces a high degree of uncertainty about successful adoption of an innovation (Premkumar & Roberts 1999). As a result, high complexity may discourage the adoption of innovation (Totnatzky & Klein 1982). This is consistent with Rogers (1995) outline of complexity in his framework of variables determining rate of adoption (Section 3.3.2). Complexity in the survey can be measured through questions $E6_8$ (system legislative compliance) and E12 (complexity of technology to meet legislative requirements).

Table 4.3 and Figure 4.6 identify the variables from the questionnaire comprising Complexity. As for H_1 and H_2, testing methods for H_3 will be undertaken in two stages. Categorical Principal Component analysis will be used to initially identify the component structure of the variables comprising Complexity, and to identify those variables which have the greatest potential to influence willingness to adopt (from those identified in Table 4.3 and Figure 4.6).

Following CATPCA analysis, multiple regression will be used to test the main dimensions of Complexity (i.e. perceptions of the complexity relating to information and records management; and perceptions of complexity relating to compliance) against the single dependent variable from the questionnaire ‘future willingness to adopt SEHRs’. This will test whether perceptions of Complexity have the potential to influence care providers’ future willingness to adopt SEHRs. Analysis of the component structure for Complexity will also identify the dimension which contains the most statistically significant influence on care providers’ willingness to adopt SEHRs.

4.7.4 Hypotheses Four and Five

The fourth and fifth hypotheses are identified below:

H_4: *That willingness to adopt shared electronic health records varies across the three tiers of the health system within Queensland;*

H_5: *That willingness to adopt shared electronic health records varies across public and private sector health facilities within Queensland.*

To test H_4 and H_5, Chi-Square analysis will be performed to analyse any statistically significant difference in willingness to adopt SEHRs between the different tiers of the health system within Queensland, and to test for any statistically differences for willingness to adopt SEHRs between public and private sector health facilities within Queensland.

4.7.5 Validating Willingness to Adopt

As detailed in sections 4.7.1 through to 4.7.6, hypotheses will primarily be tested based on Rogers' DOI factors. To reinforce the findings of the research, Davis' TAM model will be used to validate results of care providers' willingness to adopt SEHRs. Responses to questions regarding care providers' perceived usefulness of technology and SEHRs; and to care providers' perceived ease of use of technology and SEHRs will be tested through multiple regression analysis to willingness to adopt based on Rogers' DOI theory. These results should ideally complement each other, validating the results of the study.

4.8 Validity and reliability

Reliability refers to the degree to which measures are free from error and therefore yield consistent results (Zikmund 2003). Validity refers to the ability of a scale to measure what it is intended to measure (Zikmund 2003). Reliability and validity of the measures and scales will be met by ensuring that the scales follow all test assumptions appropriate to each specific test, as outlined in Zikmund (2003), Fahey (2003) and McPhail (2003).

Cronbach's alpha (α) score was one measure used to test for validity and reliability of hypotheses one to three. Cronbach's alpha (α) indicates the overall reliability of a questionnaire and values around 0.8 and 0.7 represent good model fits (Field 2009). Analysis of the model structure for hypotheses one to three was found to be reliable with Cronbach's alpha (α) above 0.8. The Cronbach's alpha (α) of hypotheses one to three were as follows (Table 4.4):

Table 4.4 Cronbach's alpha for hypotheses one to three

Cronbach's alpha (α)	**Hypotheses**
p = 0.937	*H_1: That perceptions of the variables comprising relative advantage have the potential to influence willingness to adopt shared electronic health records*

p = 0.875	*H_2: That perceptions of the variables comprising compatibility with existing systems and practices have the potential to influence willingness to adopt shared electronic health records*
p = 0.874	*H_3: That perceptions of the variables comprising complexity have the potential to influence willingness to adopt shared electronic health records.*

4.8.1 Face/content validity

Face/content validity refers to the subjective agreement amongst professionals that a scale logically appears to accurately reflect what it purports to measure (Zikmund, 2003). The questionnaire was subject to scrutiny by members of the AMAQ and academics who ensured that the scales used in the questionnaire were suitable.

4.8.2 Concurrent validity

To ensure the validity of factors examined in the questionnaire, a number of variables were included in more than one question. These items such as perceived benefits/disadvantages of technology, willingness to adopt SEHRs and levels of patient care, acted to confirm the concurrent validity of items included in the survey. The use of two independent theoretical models is also used with the aim of ensuring concurrent validity for care providers' willingness to adopt SEHRs.

4.8.3 Construct validity

In order to test for CATPCA and regression, a selection of assumptions must be met. For example, multiple regression requires data be of an interval or ratio scale, that the data has a normal distribution and ideally, that there are at least 20 observations for each independent variable (Hair et al. 1998). Other techniques such as the cross validation of answers are used to ensure consistency of answers. For example, the factor of willingness to adopt SEHRs is designed to be cross validated. General questions relating to willingness to adopt SEHRs can be checked with a specific question developed on a Likert scale specifically measuring individual care provider's willingness to adopt SEHRs. Validity of results was also tested for each hypothesis through testing relevant test assumptions such as validating the Durbin-Watson statistic and the assumption of linearity.

4.8.4 Non-response bias

Non-response bias is defined by Tustin et al. (2005) as a situation where some of the subjects do not respond to the survey and when this non-response is not accounted for during the data analysis (Zikmund 2003). Non-response bias has the potential to influence the findings of this study by casting uncertainty as to whether those care providers' who have responded this study are representative of the population of care providers'. Non-response bias is one of the main limitations of using postal questionnaires (Lund & Gram, 1998). Non-response introduces the potential for two primary effects on data. The first it introduces bias in estimates when non-respondents differ from respondents in the characteristics measured. Secondly, non-response bias contributes to an increase in the sampling variance of estimates because the effective sample size is reduced from that originally sought (Lund & Gram 1998, Retail Trade 2007).

Research suggests that the use of practices such as a well designed personalised cover letter with an official letter-head which communicates the legitimacy and benefits of the study, creates the potential for participation in questionnaire studies to be increased (Groves and Cooper 1998; Michie & Marteau 1999; Retail Trade 2007). A further technique suggested by Retail Trade (2007) is to inflate the sample size through the use of over-sampling. Further, research by Scott et al. (2011)

suggests that paper based questionnaires tend to have greater response rates by care providers' than compared to online surveys.

Scott et al. (2011) and VanGeest et al. (2007) suggest that there are three key factors which influence care providers' decisions to complete a survey. These factors include the opportunity cost of their time; their trust that the results will be used appropriately; and the perceived relevance of the survey.

Based on a consideration of the factors identified above, this study has utilised a number of techniques with the aim of increasing response rates and reducing the potential for non-response bias. These practices include a well designed cover letter, outlining the benefits and relevance of the study to care providers', and the utilisation of a large sample size covering the entire population of the AMAQ. Appendix B contains a copy of the covering letter which accompanied this study's questionnaire.

4.9 Treatment of the Data

The data obtained from the survey is a mixture of both parametric and nonparametric. Nonparametric statistical procedures typically use nominal or ordinal-scaled data and make no assumptions about the distribution of the population (Zikmund 2003). The current questionnaire is consistent with Zikmund's (2003) description, and employs primarily non-parametric data through nominal scales. Hair, Anderson, Tatham and Black (1998, p. 8) state that 'nominally scaled questions provide the number of occurrences in each class or category of variable being studied'. Therefore, the numbers assigned to objects (such as '1' for 'Yes' and '2' for 'No') have no quantitative meaning beyond indicating the presence or absence of the attribute under investigation (Hair et al. 1998). Therefore, for questions such as that identified in Figure 4.7, a nominal scale will simply indicate that, 'Yes', the respondent believes that SEHRs will improve communication with other care providers (coded as 2); 'No', the respondent does not believe that SEHRs will improve communication with other care providers (coded as 1).

Figure 4.7 Example of a nominal scale question

Do you believe that SEHRs will improve communication with other care providers?

Yes	☐$_2$
No	☐$_1$

Additionally, Likert scale questions which are arguably of an interval nature, and therefore parametric data, were included in the survey. Much debate exists as to whether or not Likert scales such as the one used in this survey (Figure 4.8) constitute an interval scale. However, in regard to the assumption of interval data with ordinal Likert scale items, in a review of the literature on this topic, Jaccard and Wan (1996, p.4) summarise, 'for many statistical tests, rather severe departures (from intervalness) do not seem to affect Type I and Type II errors dramatically.' Likert scales are ordinal, but their use in statistical procedures assuming interval data is commonplace for the reason given above (Jaccard & Wan 1996). This assumption of intervalness for Likert scales is supported by a number of authors (Goldstein & Hersen 1984; Johnson; Shaughnessy & Zechmeister 1990; Sisson & Stocker 1989). Based upon a review of the literature and the argument that ordinal like data can be treated as interval data without affecting analyses, the Likert scale items used in this study for testing have been assumed to be interval in nature.

Interval scales are defined as a scale of measurement of data according to which the differences between values can be quantified in absolute but not relative terms (The Collins English Dictionary 2000). Zikmund (2003, p.727) defines interval scales as 'a scale that not only arranges objects according to their magnitude but also distinguishes this ordered arrangement in units of equal intervals.' A common example of use of an interval scale based on the views of the authors identified above such as Jaccard and Wan (1996), and Zikmund (2003) is the Likert five point scale. The use of such a scale is illustrated in Figure 4.8:

Figure 4.8 Example of an interval scale question

Please rate how well your organization meets the following aspects of creating and keeping information required by the various Commonwealth and State bodies

(*The rating scale is as follows; 1 = Very poorly; 2 = Poorly; 3 = Adequate; 4 = Very well; 5 = Excellent)*

☐1 ☐2 ☐3 ☐4 ☐5

The above example of an interval scaled question ranks the level of awareness of respondents to legislative requirements relating to patient health records. The definitions provided suggest that data measured on a 5-point Likert scale is suitable for regression analysis. Acceptance of the definition of interval scales is critical to the regression analysis conducted in this study. The majority of variables measured on 5-point Likert scales were employed as *independent* variables throughout the analysis.

All quantitative data from the questionnaire was entered into an SPSS data file. Prior to any analysis, variables were recoded for consistency and applicability.

All nominal scaled questions were recoded so as a negative response was assigned a ‘1’ and a positive response was assigned ‘2’ for consistency in interpretation.

Responses to interval scale questions such as those measured on a 5-point Likert scale were recoded so as the positive responses were assigned a higher number compared to negative responses. For example, ‘Very poorly‘ was recoded as a ‘1’, ‘Poorly’ recoded as ‘2’, ‘Adequate’ remained as ‘3’, ‘Very well’ was recoded as ‘4’, ‘Excellent’ recoded as ‘5’.

For any interval scale questions that were measured on a 6-point scale, responses that were marked as ‘Not Applicable’ were recoded as missing data for the purpose of the data analysis.

To allow for testing of Hypothesis 4, responses to question A1 (Principal role as a care provider) were recoded as follows: GP coded as ‘1’, Specialist coded as ‘2’ and a new variable ‘Hospital staff’ was created and coded as ‘3’, and consisted of those respondents who identified as a Resident and Registrar, Salaried Specialist and Senior Medical Officer. The combination of personnel to form the ‘Hospital Staff’ variable followed a review of the literature and identification of the personnel commonly employed within Queensland Health facilities.

For the purposes of Hypothesis 5, the data was recoded to allow direct comparison between public and private sector care providers. The data was therefore recoded so as those respondents that identified as working in both private and public sectors (97 respondents) was treated as missing data. Respondents who identified as working in the public sector were recoded as ‘1’ and private sector responses was recoded as ‘2’.

A considerable volume of qualitative data was also attained from respondents on issues such as benefits of SEHRs compared to current systems, and potential complexities with legislation.

4.9.1 Variables

The dependent variable employed in this study was future willingness to adopt SEHRs. A number of factors were identified as influencing the dependent variable. The primary ‘independent’ factors employed in this study include Relative advantage, Compatibility, and Complexity. As described earlier in this chapter, each of these three factors consisted of a number of relevant variables that were grouped together for the data analysis. The definitions and identification of the variables comprising each of the three factors are identified above in sections 4.7.1 to 4.7.3.

4.10 Conclusion

This chapter has overviewed the methodology employed in the current study. Secondary data from journals, relevant texts, electronic and working paper sources concerning several topics including information management practices, diffusion of innovation theory, recordkeeping systems, and compliance with regulation and legislation within the health industry worldwide provide a conceptual and theoretical foundation for the study.

Rogers' diffusion of innovation (DOI) theory was used as a framework for the study's discussion and analysis. The aim of the research is to identify possible factors, such as potential legislative complexities relating to compliance, or probable advantages gained upon the introduction of SEHRs, which affect an innovations rate of adoption.

Data relating to perceptions of care providers' willingness to adopt SEHRs was collected through the use of a self administered questionnaire sent to all active members of the AMAQ. A large quantity of both quantitative and qualitative data was attained. The questionnaire consisted of nominal, ordinal and interval scales, to facilitate tests such as Chi-Square analysis to more detailed tests such as Categorical Principal Component Analysis (CATCPA) and multiple regression.

Once the survey had been returned from respondents, the data was entered into SPSS, and variables required for data analysis were recoded for consistency.

Hypothesis one examines whether perceived relative advantage has influenced willingness to adopt SEHRs. Categorical Principal Component Analysis will be used to identify those variables with the greatest influence on willingness to adopt SEHRs and to group these variables into their relevant dimensions. Multiple regression analysis will then be used to identify the statistical significance of the dimensions comprising Relative advantage against care providers' future willingness to adopt SEHRs.

The second hypothesis to be tested will analyse the impact of various factors of Compatibility upon care providers' willingness to adopt SEHRs. As with hypothesis one, CATPCA will be used to build the component structure of Compatibility, and multiple regression will be used to test for statistical significance.

The third hypothesis investigates whether care providers' have indicated that potential complexity has impacted upon willingness to adopt SEHRs. As with the first two hypotheses, CATPCA will identify the relevant dimensions of complexity, and multiple regression analysis will be used to test their statistical significance.

Hypothesis four (variation in willingness to adopt SEHRs across the tiers of the health system) and hypothesis five (variation in willingness to adopt SEHRs across the public and private sector) will be tested through the use of Chi-Square analysis.

A number of validity and reliability tests have been carried out throughout the research process. Such measures include ensuring content validity through the use of peer review by content experts, use of the Cronbach's alpha (α) to ensure model structures are suitable, and relevant construct validity testing procedures.

In the next chapter a summary of the data collected in the survey is provided to set the scene for data analysis to be conducted in Chapter Six and to underpin the conclusions and implications discussed in Chapter Seven.

CHAPTER 5 – OVERVIEW OF DATA

The previous chapter presented the methodology that was used to collect and analyse data. In this chapter, results of the survey are overviewed and analysed. Data such as respondent demographics; attitudes towards technology, compliance and willingness to adopt shared electronic health records (SEHRs) are outlined. Initially, an overview of respondent demographics is provided.

5.1 Respondent Profile and Demographics

In this section, a profile of respondents is presented on the basis of:

- Response rate;
- Principal role as a care provider;
- Queensland region in which they operate;
- Sector;
- Hospital size;
- Work description; and
- Ranking of technologies used.

5.1.1 Response rate

The overall number of surveys received including retired practitioners and return to sender responses totalled 750. A total of 588 valid responses were received. A valid response was considered to be one which had been returned from a currently active care provider registered with the Australian Medical Association of Queensland (AMAQ). The valid response rate (responses from those currently active members registered with the AMAQ) was 11.73%.

5.1.2 Principal role as a care provider

Based on valid responses, 214 (36.4%) respondents indicated that their principal role was that of a Specialist; 202 (34.4%) operated as a General Practitioner; 101 (17.2%) described their role as that of Resident or Registrar; 43 (7.3%) were a Salaried Specialist and 16 (2.7%) respondents indicated that their primary role as a care provider was acting as a Senior Medical Officer (refer Table 5.1). A small number of responses (2%) were received for 'Other'. These responses included 'Medical Assessor', 'Medical Research' and 'Private Emergency Department'.

Table 5.1 Principal role as care provider

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Specialist	214	36.4	36.4	36.4
	Gp	202	34.4	34.4	70.7
	Resident and Registrar	101	17.2	17.2	87.9
	Salaried Specialist	43	7.3	7.3	95.2
	Senior Medical Officer	16	2.7	2.7	98.0
	Other	12	2.0	2.0	100.0
	Total	588	100.0	100.0	

5.1.3 Queensland Region of Operations

The AMAQ breaks down their Queensland member demographics areas into 14 distinct regions (refer Table 5.2). Due to the nature of work of care providers, they are often required to work within more than a single district. The majority (64.3%) of respondents operated within the Brisbane region – 149 (25.3% in Brisbane City; 118 (20.1%) in Brisbane North, and 112 (19%) in Brisbane South.

Table 5.2 Care provider's region of operations

Region	Frequency	Percent
Brisbane City	149	25.3
Brisbane North	118	20.1
Brisbane South	112	19.0

Gold Coast	67	11.4
Toowoomba Region	48	8.2
Sunshine Coast	47	8.0
Townsville Region	32	5.4
Ipswich Region	27	4.6
Cairns Region	25	4.3
Rockhampton Region	21	3.6
Mackay Region	15	2.6
North Coast Region	11	1.9
Mt Isa	2	0.3
Other	10	1.7

5.1.4 Sector

Table 5.3 provides an overview of the sectors operated in by respondents. Almost half of the respondents (49.9%) indicated that they operated within the Private sector (Table 5.3). One third of the respondents (33.6%) indicated that they operated solely within the Public sector, and 16.5% respondents operated within both the public and private sectors.

Table 5.3 Sector which care providers operate within

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Private	293	49.8	49.9	49.9
	Public	197	33.5	33.6	83.5
	Public and Private	97	16.5	16.5	100.0
	Total	587	99.8	100.0	
Missing	System	1	.2		
Total		588	100.0		

The greater number of respondents from the private sector could potentially impact trialling methods of SEHRs, and eventual willingness to adopt. Adoption of SEHRs has historically been trialled more widely within the public sector. The increased exposure to SEHRs within the public sector could potentially lead to a greater willingness to adopt from public sector employees.

5.1.5 Hospital Size and Age

The majority of respondents (45.4%) indicated that they operated within a large hospital. A large hospital is defined as one which has more than 200 beds. One hundred and seventeen (21.8%) of respondents indicated that they operated within a small hospital (refer Table 5.4)

Table 5.4 Size of hospital

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Small	117	19.9	21.8	21.8
	Large	244	41.5	45.4	67.2
	N/A	176	29.9	32.8	100.0
	Total	537	91.3	100.0	
Missing	System	51	8.7		
Total		588	100.0		

5.1.6 Best Description of Work Organisation

Respondents were asked to best describe the type of work organisation they were involved with. Two hundred and seventy nine respondents (47.6%) indicated that they worked within a Hospital/Medical Care environment (Table 5.5). The next largest respondent group was made up of those working within Group Practice (26.8%), with the self employed professional group the third most prominent category (18.6% of respondents). Additionally, 26 respondents (4.4%) indicated that they worked within two or more categories simultaneously.

Table 5.5 Best description of work category

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Hospital/Medical Centre	279	47.4	47.6	47.6
	Group Practice	157	26.7	26.8	74.4
	Ambulatory care clinic	8	1.4	1.4	75.8
	Long term care/rehabilitation centre	2	.3	.3	76.1

	College/University	2	.3	.3	76.5
	Consulting firm	3	.5	.5	77.0
	Self employed professional	109	18.5	18.6	95.6
	Other work setting	26	4.4	4.4	100.0
	Total	586	99.7	100.0	
Missing	System	2	.3		
Total		588	100.0		

5.1.7 Computer Applications Used

The medical community represents a diverse community. Within different roles and environments, many types of computer applications are likely to be used. Of interest to this study, current usage of technology may influence perceptions of SEHR compatibility with current systems. Respondents were asked to identify those applications which they commonly use in their daily tasks (Table 5.6).

Table 5.6 Computer applications used

Technology Type	Frequency	Percent
Administrative	481	82.1
Database searching	442	75.4
Colleague interaction	395	67.4
Prescription Use	344	58.7
Statistic collection	242	41.3
Decision Support	219	37.4

The three most commonly used computer applications indicated by respondents were:

- Administrative (481 responses);
- Database searching (442 responses); and
- Colleague interaction (395 responses).

To positively influence care providers' perceptions of SEHRs and their willingness to adopt, the most commonly used applications identified by care providers' in their daily activities should be identified as strengths of SEHRs. Therefore based on the results of the questions in section 5.1.7, the implementation of SEHRs could therefore target improvements in the way in which care providers' interact with technology applications in areas such as:

- Administrative use;
- Database searching; and
- Colleague interaction.

5.2 Attitudes to Current Use of Technology

The aim of this section of the survey was to identify respondents' general attitudes towards the use of technology within their roles as care providers. Attitudes towards either the positive or negative extreme could possibly influence responses in later sections of the survey, namely their willingness to adopt SEHRs.

Respondents were provided with a number of questions in relation to their thoughts on technology issues in general. These issues included:

- Perception of the level of technological change within daily roles over the past five years;
- Ease of use of technology as a factor that would influence acceptance of technology;
- Input into the level of technology usage within the organisation;
- Personal perception of the use of technology for work use;
- The impact of technology on professional autonomy and/or control over work;
- The impact of technology on continuity and quality of care;
- The ability of technology to improve individual care provider performance;
- Types of technology used within daily practice; and
- Potential and actual benefits of technology usage in relation to information needs.

5.2.1 Level of technology change over the past five years

The technology section of the survey initially identified care providers' perceptions in regard to the level of change in technology throughout the past five years. Table 5.7 illustrates that the majority of respondents (79.2%) identified either an increase (42.4%) or a large increase (36.8%) in the level of technological change over the past five years.

Table 5.7 Level of change in technology over the past five years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	large Increase	215	36.7	36.8	36.8
	Increase	248	42.3	42.4	79.1
	Steady	116	19.8	19.8	99.0
	Decrease	1	.2	.2	99.1
	No Technology Usage	5	.9	.9	100.0
	Total	585	99.8	100.0	
Missing	System	1	.2		
Total		586	100.0		

5.2.2 Ease of use of technology as a factor that would influence acceptance of technology

Ease of use of technology could be considered a significant factor in determining individuals' acceptance of technology. Technology which is easy or common to use, such as most typical Windows packages, are often accepted with greater ease. This theme was certainly demonstrated by responses to this question in the survey. The vast majority of respondents (96.6%) indicated that ease of use of technology would positively influence acceptance of technology (refer Table 5.8).

Table 5.8 Do you perceive 'ease of use' technology as a factor which would influence acceptance of technology?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	564	96.2	96.6	96.6
	No	20	3.4	3.4	100.0
	Total	584	99.7	100.0	
Missing	System	2	.3		
Total		586	100.0		

Results from sections 5.2.1 and 5.2.2 show that care providers' acknowledge that technology is ever evolving, and the key to improving willingness to adopt technological innovations such as SEHRs is to focus on their ease of use during care providers' most commonly undertaken daily activities.

5.2.3 Level of input towards technology use within organisation

The next section of the technology area sought to identify whether respondents had any input into the level of technology usage within their organisations. Prior input in the development or implementation of technology could potentially influence willingness to adopt SEHRs. Approximately half of the respondents (52.7%) indicated that they had had some degree of input into the level of technology usage within their organisation (Table 5.9).

Table 5.9 Have you had any input into the level of technology used within your organisation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	307	52.4	52.7	52.7
	No	276	47.1	47.3	100.0
	Total	583	99.5	100.0	
Missing	System	3	.5		
Total		586	100.0		

5.2.4 Perceptions of usefulness of technology

This component of the technology section identified personal perceptions of the use of technology for work purposes. Table 5.10 indicates that the majority of respondents (87.9%) rated technology, in varying degrees, as being useful in performing work duties.

Table 5.10 Technology for work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Complex and Cumbersome	67	11.4	11.5	11.5
	Useful in performing daily duties	376	64.2	64.4	75.9
	Assists in selected duties	137	23.4	23.5	99.3
	Other	4	.7	.7	100.0
	Total	584	99.7	100.0	
Missing	System	2	.3		
Total		586	100.0		

Based on the results of the above table, in order to positively influence care providers' willingness to adopt technology - specifically SEHRs, the technology needs to be perceived as a tool which will enable improved work performance. These improvements must be able to be clearly defined through a number of key benefits – namely compatibility with existing work practices and applications, and relative ease of use.

5.2.5 Perceptions of ability of technology to provide autonomy

Respondents were next asked to identify their perceptions regarding the impact of technology, specifically whether the use of technology facilitates professional autonomy. Approximately two-thirds of respondents (63%) indicated that technology did provide some degree of professional autonomy (Table 5.11). These findings were verified with a follow up question which was reworded, asking respondents to consider whether technology threatens work autonomy. Consistent with the first response, approximately three quarters of respondents (78.4%) indicated that they did not perceive technology as threatening their work autonomy.

Table 5.11 Does the use of technology provide any professional autonomy?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	366	62.5	63.0	63.0
	No	215	36.7	37.0	100.0
	Total	581	99.1	100.0	
Missing	System	5	.9		
Total		586	100.0		

The next question identified care providers' perceptions as to whether technology could lead to managerial control. Again, consistently with the previous two questions, approximately two-thirds of respondents (66.8%) identified that they did not perceive technology as leading to managerial control over their work (Table 5.12).

Table 5.12 Does the use of technology lead to managerial control over your work?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	194	33.1	33.2	33.2
	No	390	66.6	66.8	100.0
	Total	584	99.7	100.0	
Missing	System	2	.3		
Total		586	100.0		

The results of section 5.2.5 indicate that care providers' do not appear threatened by technology, in that the majority of respondents indicated that the use of technology does not threaten work autonomy or lead to managerial control, but rather helps facilitate professional autonomy.

5.2.6 Perceived impact of technology on care provider performance

Respondents' were asked to provide an indication as to whether they perceived technology as improving their performance as a care provider. Once again, results were consistent with previous responses, and over three quarters of respondents (77.7%) indicated that they perceived the use of technology as improving their performance as a care provider (Table 5.13).

Table 5.13 Does the use of technology improve your performance as a care provider?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	454	77.5	77.7	77.7
	No	130	22.2	22.3	100.0
	Total	584	99.7	100.0	
Missing	System	2	.3		
Total		586	100.0		

5.2.7 Types of technology used within daily practice

After establishing attitudes and perceptions towards technology and the role it plays within the daily environment of the care provider, the next section of the survey identified those common activities performed by care providers' which utilised technology. The activity which care providers' identified as most commonly using technology for was data entry (77.8%). The use of technology for 'reference' and for 'treatment' use were the second and third most commonly identified uses of technology in patient care (67.7% and 60.5% respectively, refer Table 5.14).

Table 5.14 The most common daily uses of technology

Technology Type	Frequency	Percentage
Data entry	455	77.8
Reference	396	67.7
Treatment	354	60.5
Clinical visits	289	49.4

Decision Support	287	49.1
Prescription entry	282	48.2
Advanced use	104	17.8
Other	43	7.0

As indicated above, there were a number of responses to ‘Other’ for this section. The most common response category for ‘Other’ was the use of technology to identify patient trends/statistical collection/diagnosis investigation (11 responses).

5.2.8 Perceptions of potential and actual benefits of technology in clinical tasks

Once respondents had identified general uses of technology within their daily roles, they were asked to indicate, using a five point scale ranging from 5 = great benefit down to 1 = no benefit, whether they believed that technology had (a) the *potential* to provide benefit or (b) *actually* provided benefit in relation to a number of clinical tasks. The questions covered the following topics:

- Improved accessibility to general patient information;
- Improved accuracy of patient identification;
- Greater accessibility to patient treatment and support information;
- Reduced time spent on routine administrative tasks;
- Increased time effectiveness with patients;
- Elimination of medical errors;
- Facilitation of rapid delivery of test results; and
- Improved provider/patient satisfaction with care and treatment.

Table 5.15 identifies responses to potential benefits and actual benefits of technology.

Table 5.15 Potential and actual benefits of technology

Care providers perceive that technology has the ability to benefit the following areas:	Great benefit	Moderate benefit	Some benefit	Little benefit	No benefit	Not applicable
Potential Accessibility to patient history	59.5	22.3	8.9	2.4	3.1	3.8
Actual Accessibility to patient history	*17.1*	*26.0*	*28.1*	*14.8*	*8.3*	*5.7*
Potential Improved accuracy	41.1	26.8	14.9	7.2	6.7	3.3
Actual Improved accuracy	*16.6*	*25.0*	*27.8*	*14.7*	*11.4*	*4.7*
Potential Accessibility to treatment and support	47.2	27.4	13.0	5.6	4.1	2.7
Actual Accessibility to treatment and support	*12.2*	*26.4*	*31.4*	*16.3*	*8.7*	*5.0*
Potential Reduced admin time	38.4	30.7	14.7	6.8	6.2	3.3
Actual Reduced admin time	*10.7*	*21.2*	*29.3*	*17.6*	*15.8*	*5.5*
Potential Increased time effectiveness	28.3	31.7	19.2	11.1	5.0	4.6
Actual Increased time effectiveness	*9.3*	*19.8*	*29.6*	*20.5*	*14.5*	*6.4*
Potential Elimination of errors (site, person etc)	27.6	25.2	18.8	9.7	7.4	11.4
Actual Elimination of errors (site, person etc)	*8.0*	*19.6*	*26.3*	*19.0*	*13.7*	*13.5*
Potential Elimination of errors (surgery etc)	22.5	17.4	22.0	13.1	11.7	13.3
Actual Elimination of errors (surgery etc)	*6.6*	*12.8*	*25.2*	*23.3*	*16.7*	*15.5*
Potential Rapid delivery of results	64.2	21.2	6.2	1.9	2.6	3.9
Actual Rapid delivery of results	*29.5*	*30.5*	*20.2*	*10.8*	*5.1*	*3.8*
Potential Improved provider satisfaction	27.7	34.4	18.8	8.0	6.5	4.1
Actual Improved	*9.1*	*24.9*	*30.9*	*19.4*	*10.3*	*5.5*

provider satisfaction						
Potential Improved patient satisfaction	21.4	28.6	22.1	13.7	7.7	6.5
Actual Improved patient satisfaction	*6.2*	*17.5*	*34.3*	*22.5*	*12.2*	*7.4*

Table 5.15 illustrates that respondents perceived that potential benefits of technology and perceived actual benefits of technology were substantially different. In all statements where respondents indicated that technology has a potentially great benefit, the actual perceived advantage was less. A paired samples t-test was conducted to compare the ‘potential benefit’ and the ‘actual benefit’ of technology in relation to patient care. An examination of the mean scores of ‘potential benefit’ and ‘actual benefit’ for each aspect of patient care identified statistically significant differences for each aspect. The three most significant results were:

- Accessibility to patient history (M=-1.098, SD=1.368);
- Reduced admin time (M=-1.022, SD=1.337); and
- Accessibility to treatment and support (M=-0.978, SD=1.29).

The statistically significant difference in mean scores between ‘potential benefit’ and the ‘actual benefit’ of technology suggests that technology has the potential to provide a great level of benefit, however in actual practice, care providers found that it does not perform as expected. The aspects which contained the most significant results are also areas where SEHRs have the greatest potential to provide improvements to patient care. Unlike the examples above where technology in general has not met care providers’ expectations in a number of areas, SEHRs need to be able to show actual benefits in these areas to improve care providers’ willingness to adopt.

The final component of section B was to identify potential and actual benefits of the use of technology to facilitate communication between different groups of care providers. Respondents were asked to rate their responses on a five point scale, ranging from 5 = strongly agree down to 1 = strongly disagree.

Table 5.16 outlines the results for perceptions of the potential and actual ability of technology to facilitate communication amongst the different groups of care providers'.

Table 5.16 Potential and actual ability of technology to facilitate communication

Care providers perceive technology as facilitating communication between:	**Benefits**	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**n/a**
Clinicians	Potential	47.9	38.4	9.6	2.2	1.4	0.5
	Actual	*15.8*	*36.9*	*30.5*	*11.3*	*3.4*	*2.1*
Caregivers	Potential	28.8	38.9	24.7	4.3	2.2	1.0
	Actual	*7.6*	*19.8*	*38.8*	*20.5*	*8.4*	*4.8*
Organisational Personnel	Potential	33.8	40.8	20.2	2.9	1.0	1.2
	Actual	*13.4*	*31.3*	*35.2*	*12.9*	*4.5*	*2.7*
Specialists	Potential	45.9	38.5	11.1	2.4	10	1.0
	Actual	*13.3*	*30.3*	*32.7*	*15.0*	*5.9*	*2.9*
Pharmacists	Potential	39.5	40.3	14.8	2.4	1.2	1.9
	Actual	*10.7*	*26.4*	*32.5*	*16.2*	*7.8*	*6.4*

As with the previous section, a paired samples t-test was conducted to compare the 'potential benefit' and the 'actual benefit' of technology in relation facilitation of communication between care providers. An examination of the mean scores of 'potential benefit' and 'actual benefit' for each aspect of the benefit of technology in relation to facilitation of communication between care providers identified statistically significant results in each area. The three most statistically significant results were:

- Pharmacists (M=-1.116, SD=1.336);
- Caregivers (M=-1.017, SD=1.234); and
- Specialists (M=-1.017, SD=1.206).

The statistically significant differences between mean scores of 'potential benefit' and 'actual benefit' again suggests that respondents expected that technology would potentially greatly help in communication between care providers, however the actual benefit realised was much less.

The gap analysis conducted in tables 5.15 and 5.16 could provide considerable benefit in establishing policies and procedures for the successful implementation of SEHRs.

5.3 Perceptions of the impact of technology on patient care

Progressing from technology in general, this component of the survey aimed at identifying respondents' agreement or disagreement with statements relating to the use of technology specifically for patient care. When examined in conjunction with technology in general, this part of the survey may be able to be used to help provide information relating to the likelihood of care providers' acceptance or lack of acceptance of SEHRs.

Respondents were asked to provide feedback regarding whether they perceived technology as helping to provide continuity of care. The vast majority of respondents (86.3%) indicated that technology did in fact assist in providing continuity of care (Table 5.17).

Respondents were also asked to identify whether they perceived technology as a tool which improves quality of care. As with the previous response, the vast majority of respondents (82.2%) indicated that they perceived that the use of technology did improve the quality of care (Table 5.18), providing a high degree of consistency between responses.

Table 5.17 Does the use of technology help in providing continuity of patient care?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	504	86.0	86.3	86.3
	No	80	13.7	13.7	100.0
	Total	584	99.7	100.0	
Missing	System	2	.3		
Total		586	100.0		

Table 5.18 Does the use of technology help in improving quality of patient care?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	480	81.9	82.2	82.2
	No	104	17.7	17.8	100.0
	Total	584	99.7	100.0	
Missing	System	2	.3		
Total		586	100.0		

The responses above indicate the respondents' believe that technology is perceived by care providers as facilitating continuity and quality of patient care. These factors have the potential to also be important considerations in care providers' willingness to adopt SEHRs.

Respondents were then asked to provide their views to a number of statements on a five point scale ranging from 1 = strongly disagree to 5 = strongly agree to. The first statement asked whether respondents' perceived technology as increasing the cost of treatment for patient care. The majority of respondents agreed with this statement, with 55.6% indicating either a strongly agree or agree response to this question (Table 5.19).

Table 5.19 Technology has increased the cost of patient care

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	30	5.1	5.1	5.1
	Disagree	80	13.6	13.7	18.9
	Neutral	148	25.2	25.4	44.3
	Agree	196	33.3	33.6	77.9
	Strongly Agree	128	21.8	22.0	99.8
	N/A	1	.2	.2	100.0
	Total	583	99.1	100.0	
Missing	System	5	.9		
Total		588	100.0		

Respondents were then asked to identify whether they perceived the use of technology as generally improving the outcomes of patient treatment. Again, the majority of respondents indicated that they either strongly agreed, or agreed with this statement (53.9%, Table 5.20).

Table 5.20 Technology improves the outcome of patient treatment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	56	9.6	9.6	9.6
	Agree	259	44.2	44.3	53.9
	Neutral	193	32.9	33.0	87.0
	Disagree	59	10.1	10.1	97.1
	Strongly Disagree	17	2.9	2.9	100.0
	Total	584	99.7	100.0	
Missing	System	2	.3		
Total		586	100.0		

The third component of this section of the survey aimed at identifying whether care providers' perceived patients as choosing a care provider based on the technology employed in that practice. Approximately 53% of respondents indicated a neutral response, and 31% of respondents disagreed or strongly disagreed with the statement (Table 5.21), indicating that care providers did not perceive the use of technology was a factor in patients' choice of a specific care provider.

Table 5.21 The use of technology has lead to patients choosing this practice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	14	2.4	2.4	2.4
	Agree	73	12.5	12.5	14.9
	Neutral	315	53.8	53.9	68.8
	Disagree	118	20.1	20.2	89.0
	Strongly Disagree	63	10.8	10.8	99.8
	N/A	1	.2	.2	100.0
	Total	584	99.7	100.0	
Missing	System	2	.3		
Total		586	100.0		

Respondents' were then asked to identify whether they perceived the use of technology in patient care as reducing errors in prescribed medication. The majority of respondents' (58.2%) indicated that they either strongly agreed, or agreed that the use of technology did in fact reduce error in prescribed medication (Table 5.22).

Table 5.22 The use of technology reduces error in prescribed medication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	76	13.0	13.1	13.1
	Agree	262	44.7	45.1	58.2
	Neutral	156	26.6	26.9	85.0
	Disagree	61	10.4	10.5	95.5
	Strongly Disagree	26	4.4	4.5	100.0
	Total	581	99.1	100.0	
Missing	System	5	.9		
Total		586	100.0		

The final component of Section C – Patient Care, aimed at identifying whether care providers' perceived the use of technology in patient care as providing less timely health care. This statement was deliberately worded negatively. It would therefore be expected that more respondents would disagree with the statement than agree, indicating that respondents perceived technology as providing timelier healthcare. Table 5.23 provides the results.

Table 5.23 The use of technology produces less timely health care

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	14	2.4	2.4	2.4
	Agree	74	12.6	12.8	15.3
	Neutral	242	41.3	41.9	57.2
	Disagree	189	32.3	32.8	89.9
	Strongly Disagree	58	9.9	10.1	100.0
	Total	577	98.5	100.0	
Missing	System	9	1.5		
Total		586	100.0		

As expected, a number of respondents indicated that they either disagreed, or strongly disagreed with the statement (42.9%). Only 15.3% of respondents' agreed or strongly agreed with the statement.

Findings from section 5.3 indicate that care providers' perceive technology as helping to improve the quality and outcome of patient care. This could be another important consideration in determining care providers' willingness to adopt SEHRs.

5.4 Compliance

The fourth section of the survey aimed at identifying respondents' awareness of various compliance issues surrounding their work role and their organisation. Issues ranged from knowledge of legislation governing their work role, to the impact that legislation and best practice has had upon their daily practices. The initial section of this component of the survey examined respondents' general awareness of whether their organisation follows any voluntary Standards or codes of practice relating to the management of patient information (such as AS4400 or the Royal Australian College of General Practitioners (RACGP) Code of Practice.

While almost half of respondent's (47.9%) indicated that their organisation did follow voluntary Standards or codes of practice, 42% were unsure of whether their organisation did so (refer Table 5.24).

Table 5.24 Does your organisation follow any voluntary Standards and codes of practice relating to the management of patient information?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	58	9.9	17.2	17.2
	Yes	280	47.6	82.8	100.0
	Total	338	57.5	100.0	
Missing	System	250	42.5		
Total		588	100.0		

Respondents that answered yes to the previous question where asked to indicate which Standards and/or Codes of Practice were followed. The RACGP Code of Practice and the Privacy Act were the most common responses.

Another source of concern is the next section of the survey, which examined whether respondents had an understanding of the Commonwealth and State recordkeeping legislation impacting upon their organisation. Approximately three-quarters of respondents (73.6%) indicated that they did not have an understanding of the relevant Commonwealth or State legislation relating to recordkeeping (Table 5.25). This again could potentially be a concern, in that care providers' may not be creating, keeping and maintaining the right records, for the right amount of time.

Table 5.25 I have an understanding of Commonwealth and State legislation impacting upon my organisation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	154	26.3	26.4	26.4
	No	429	73.2	73.6	100.0
	Total	583	99.5	100.0	
Missing	System	3	.5		
Total		586	100.0		

For those care provider's who answered 'Yes' to the previous questions, they were then asked to specify which Commonwealth and State statutes for information management their organisation adhered to. 'Privacy Act' was the most common response (75 responses

Based on the high number of respondents' who indicated that they did not have an understanding of the Commonwealth and State legislation impacting upon their organisations (73.6%), the above results could be a potential area where the use of technology (and SEHRs specifically) could be promoted to improve compliance with legislative requirements. For example, compliance with legislative requirements could be improved through inbuilt references in systems such as electronic document and records management systems or SEHRs to the relevant disposal authority for specific classes of records. This would result in classes of records being maintained for their minimum retention period, preventing their early disposal. Compliance with legislative requirements may also be met through implementation of strict controls over the management of the data contained within an individual's health record. The implementation of the PCEHR system (refer Chapter 3) for example, contains a number of control mechanisms and regulatory requirements for the appropriate management and control of patient data. This may include preventing any unauthorised modification of the data contained within health records. Simplification of the compliance process (e.g. through national standards and legislation) could have significant potential to increase care providers' willingness to adopt SEHRs.

The next element of the survey aimed at identifying care providers' agreement or disagreement with a number of statements relating to how legislation had impacted upon the care provider's role.

Almost 60% of respondents agreed or strongly agreed that they had become more aware of legislative requirements for patient records throughout the past five years (Table 5.26).

Table 5.26 Increased awareness of legislative requirements for patient records

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	74	12.6	12.7	12.7
	Agree	272	46.4	46.7	59.5
	Neutral	164	28.0	28.2	87.6
	Disagree	39	6.7	6.7	94.3
	Strongly Disagree	18	3.1	3.1	97.4
	N/A	15	2.6	2.6	100.0
	Total	582	99.3	100.0	
Missing	System	4	.7		
Total		586	100.0		

Fifty-nine percent of respondents either agreed or strongly agreed with the statement that increased privacy legislation had impacted upon their practice within the past five years (Table 5.27). This result would undoubtedly be higher if surveyed post 1 July 2009, with the introduction of new privacy legislation in Queensland in the form of the *Information Privacy Act 2009.*

Table 5.27 Increased impact of privacy legislation upon organisation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	112	19.1	19.2	19.2
	Agree	232	39.6	39.8	59.0
	Neutral	145	24.7	24.9	83.9
	Disagree	45	7.7	7.7	91.6
	Strongly Disagree	25	4.3	4.3	95.9
	N/A	24	4.1	4.1	100.0
	Total	583	99.5	100.0	
Missing	System	3	.5		
Total		586	100.0		

While the results shown in Tables 5.26 and 5.27 illustrate that respondents indicated an increased awareness of legislative requirements, they potentially may not fully appreciate the impact of these requirements upon themselves and their organisations. For example, there are legal and regulatory requirements throughout various legislation and other regulatory and accountability instruments and systems which establish explicit requirements to make and keep records (or they imply that records should be created). This could potentially be explained through the findings in Table 5.25, which reveal that approximately 73% of respondents indicated that they did not have an understanding of the relevant Commonwealth or State legislation impacting upon recordkeeping in their organisation.

Respondents were also asked to specify *how* increased privacy legislation had impacted upon their practice in the past five years (Table 5.28).

Table 5.28 The impact of privacy legislation upon organizations

Privacy impact	Frequency
Makes accessing records from others/contacting relations harder	48
Increased patient consent forms/careful about information given	44
Increased Workload	34
Negatively/Privacy has made things too hard	28
Awareness increase	26
More care taken on information/increased documentation	25
Other	21

Responses indicate that over the past five years, increased privacy legislation has generally had a negative impact from a care provider's perspective (Table 5.28). Areas where privacy legislation has had a considerable impact includes, accessing records and contacting relatives of patients. Respondents identified that it is now much harder and more difficult to undertake these activities. Additionally, respondents indicated that, as a result of increased privacy legislation, they have had to take more care and improve documentation relating to patient information, resulting in more comprehensive records.

The next section of the survey was aimed at identifying whether an increase in litigation over the past five years has had an impact upon the management of patient records. Consistent with previous opinions, the majority of respondents (55.2%)

agreed with the statement that an increase in legislation had impacted upon the management of their patient records (Table 5.29).

Table 5.29 **Increased legislation has impacted upon the management of patient records**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	128	21.8	22.0	22.0
	Agree	194	33.1	33.3	55.2
	Neutral	149	25.4	25.6	80.8
	Disagree	60	10.2	10.3	91.1
	Strongly Disagree	33	5.6	5.7	96.7
	N/A	19	3.2	3.3	100.0
	Total	583	99.5	100.0	
Missing	System	3	.5		
Total		586	100.0		

Respondents who agreed with the previous statement were asked to identify how increased legislation had impacted upon the management of their patient records (Table 5.30).

Table 5.30 **How has increased legislation impacted upon the management of patient records?**

Privacy impact	Frequency
Need for greater records to be kept; Increased detail/accuracy/better notes	137
More care taken on information/increased documentation	33
Adverse effects/need for risk management	21
Greater fear of litigation	17
Increased Workload	16
Absence of opinion from records	13
Other	15

Respondents indicated that the greatest impact of increased legislation has been upon the need for more accurate records with increased detail to be kept (Table 5.30). This could be related directly back to the findings identified in Table 5.28 (where care providers' were asked to identify how privacy had impacted upon their organisation), and care providers' identified the need for more comprehensive patient records. Systems that are designed to help meet the various regulatory and legislative requirements impacting upon care providers relating to the creation and maintenance of full and accurate patient records will provide obvious benefits for care providers.

The management of patient records, in compliance with legislative requirements, is an area where the key benefits of SEHRs can be actively promoted. Advantages and benefits relating to reduced workloads in creating and managing patient records, and improved levels of compliance with legislative and regulatory requirements are key advantages which could be promoted to improve care providers' willingness to adopt SEHRs.

The next component of the questionnaire was aimed at establishing how well respondents perceived their organisations as complying with Commonwealth and State needs for creating and maintaining records. Respondents were asked to indicate their agreement or disagreement, based on a five point scale, with a number of statements. The first was whether they perceived that their organisation gathered and kept all appropriate information and records. Almost two-thirds of respondents (64.9%, refer Table 5.31) rated their organisation's procedures for gathering and keeping records as either excellent or very good.

Table 5.31 How well does your organisation gather and keep records?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Excellent	122	20.8	21.2	21.2
	Very Well	252	43.0	43.8	64.9
	Adequate	178	30.4	30.9	95.8
	Poorly	22	3.8	3.8	99.7
	Very Poorly	2	.3	.3	100.0
	Total	576	98.3	100.0	
Missing	System	10	1.7		
Total		586	100.0		

Respondents were then asked to identify how well their organisation stored corporate information. Again, the majority of respondents' indicated that they perceived that their organisation maintained organisational information well (65.6%) in Table 5.32.

Table 5.32 How well does your organisation store information?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Excellent	140	23.9	24.3	24.3
	Very Well	238	40.6	41.3	65.6
	Adequate	176	30.0	30.6	96.2
	Poorly	20	3.4	3.5	99.7
	Very Poorly	2	.3	.3	100.0
	Total	576	98.3	100.0	
Missing	System	10	1.7		
Total		586	100.0		

Next, the respondents were asked to assess the reliability of the information held by their organisation. For information to be considered reliable, it must be able to be verified as a true and accurate representation of what it purports to represent. Almost two-thirds of respondents (63%) indicated that their organisation excelled or met very well the requirements to ensure the reliability of their records (Table 5.33).

Table 5.33 How well does your organisation meet the requirements for reliable organisational information?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Excellent	122	20.8	21.2	21.2
	Very Well	241	41.1	41.8	63.0
	Adequate	191	32.6	33.2	96.2
	Poorly	21	3.6	3.6	99.8
	Very Poorly	1	.2	.2	100.0
	Total	576	98.3	100.0	
Missing	System	10	1.7		
Total		586	100.0		

Respondents were then asked to rate how well organisational information was protected. Sixty-three percent of respondents perceived their organization's information protection methods as either excellent or very well managed (Table 5.34).

Table 5.34 How well does your organisation protect information?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Excellent	118	20.1	20.5	20.5
	Very Well	243	41.5	42.3	62.8
	Adequate	179	30.5	31.1	93.9
	Poorly	30	5.1	5.2	99.1
	Very Poorly	5	.9	.9	100.0
	Total	575	98.1	100.0	
Missing	System	11	1.9		
Total		586	100.0		

The final element of this section of the survey was for respondents' to rate the impact of increasing media coverage relating to medical errors upon the way in which their organisation makes and keeps records. Respondents' ratings of such impact measured on a five point scale ranging from 1 = Strong impact to 5 = No impact are shown in Table 5.35.

Table 5.35 Impact of the media on organisational making and keeping of records

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strong Impact	112	19.1	19.3	19.3
	Slight Impact	171	29.2	29.5	48.9
	Steady	155	26.5	26.8	75.6
	Little Impact	89	15.2	15.4	91.0
	No Impact	52	8.9	9.0	100.0
	Total	579	98.8	100.0	
Missing	System	7	1.2		
Total		586	100.0		

Approximately half of the respondents (48.9%) indicated that increasing media coverage has had either a strong or a slight impact on their organisational methods of making and keeping records. Respondents who indicated that increasing media coverage has had an impact on the making and keeping of records were then asked to specify what that impact was (Table 5.36).

Table 5.36 How the impact of increasing media coverage has impacted on the way in which my organisation makes and keeps records?

Privacy impact	Frequency
Better processes/recordkeeping/documentation	47
More aware of need for better notes/information	28
Emphasis on error reduction/risk management/following protocols	26
Increased administration	24
Other	7

The majority of responses indicated that increasing media coverage had resulted in better information management practices (Table 5.36). However, respondents identified that the consequence of better information management practices was an increased workload through an increase in administration time spent having to produce this better information.

This section of the survey has demonstrated that respondents' generally rated their records and information management practices as being very good, but at the same time stated that their knowledge of legislative requirements (for example, those required under the *Public Records Act 2002)* was relatively low, which may impact on the validity of their assessments.

5.5 Shared Electronic Health Records

The previous four sections of the survey have established:

- Respondent demographics;
- Respondent attitudes towards technology in general;
- Respondent attitudes towards technology in relation to patient care; and

- Respondent knowledge of legislation impacting upon their organisation.

The final section of the survey examines respondents' attitudes specifically towards SEHRs. This section examines their knowledge of SEHRs; willingness to adopt, and specific factors impacting upon care providers' willingness to adopt SEHRs.

Initially, care provider knowledge of SEHRs was assessed by identifying whether they were aware of trials which have been conducted involving SEHRs throughout Australia. Surprisingly, as shown in Table 5.37, over half of the respondents' (57.6%) were not aware of trials which had been conducted involving SEHRs.

Table 5.37 Are you aware of trials of SEHRs in systems such as HealthConnect?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	247	42.2	42.4	42.4
	No	336	57.3	57.6	100.0
	Total	583	99.5	100.0	
Missing	System	3	.5		
Total		586	100.0		

The results identified in Table 5.37 could potentially be explained by the respondent demographics, in that approximately 50% of respondents operated solely within the private sector, whilst the trials of SEHRs have been undertaken more widely within the public sector.

Those who were aware of the trials which had been performed were asked to specify whether the results of the trials had any positive or negative influence upon their willingness to adopt SEHRs. Table 5.38 shows that in excess of three quarters of those who were aware of the trials (82.6%) indicated that the results would not influence their willingness to adopt SEHRs.

Table 5.38 Have the results of these trials had any influence on your willingness to adopt SEHRs?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	56	9.6	17.4	17.4
	No	266	45.4	82.6	100.0
	Total	322	54.9	100.0	
Missing	System	264	45.1		
Total		586	100.0		

Respondents were then asked to identify whether their organisation was contemplating future use, been previously involved in, or was currently involved in any trials of a system of SEHRs such as HealthConnect. Responses reveals that respondents have had little previous involvement with SEHRs. Only 15.2% of respondents indicated that they either had previously, or were currently using SEHRs. One quarter of respondents indicated that their organisation was likely to be involved in future trials of SEHRs.

Based upon current knowledge of, and current or previous usage of SEHRs, respondents were then asked to illustrate both their current and future willingness to adopt SEHRs. Generally, respondents were more willing to adopt SEHRs in the future (72%) rather than currently (63.5% - see Table 5.39). This is a common attitude towards change management issues. Organisational culture and personnel preferences are often the most difficult constraint to overcome when implementing new procedures or technology.

Table 5.39 Care providers' willingness to adopt SEHRs

Care providers willingness to adopt SEHRs	Extremely willing	Very willing	Somewhat willing	Some concerns	Extremely against
Current	15.8	16.3	31.4	28.0	8.5
Future	19.2	21.2	31.5	23.2	4.9

There are potentially a number of factors which may either positively or negatively influence care providers' willingness to adopt SEHRs. Factors were provided and respondents had to indicate whether the factors listed would positively (Table 5.40) or negatively (Table 5.41) affect their willingness to adopt SEHRs. Categories which were provided as potentially influencing willingness to adopt, either currently or in the future included:

- Increased/decreased workloads;
- Increased/decreased care provider privacy;
- Increased/decreased patient privacy;
- Increased/decreased administrative costs;
- Increased/decreased satisfaction;
- Increased/decreased care;
- Increased/decreased complexity; and
- Increased/decreased compliance.

Table 5.40 and 5.41 illustrate the positive and negative factors respondents identified as impacting upon their willingness to adopt SEHRs.

Table 5.40 Factors which may positively impact upon willingness to adopt SEHRs

Would the following influence your willingness to adopt SEHRs?	**Yes**	**No**
Current decreased workloads	37.6	62.4
Future decreased workloads	*59.2*	*40.8*
Current improved care provider privacy	22.6	77.4
Future improved care provider privacy	*36.1*	*63.9*
Current improved patient privacy	22.9	77.1
Future improved patient privacy	*36.5*	*63.5*
Current decreased admin costs	26.5	73.5
Future decreased admin costs	*47.3*	*52.7*
Current improved satisfaction	24.4	75.6
Future improved satisfaction	*43.7*	*56.3*
Current improved care	42.5	57.5
Future improved care	*71.4*	*28.6*
Current reduced complexity	31.7	68.3
Future reduced complexity	*54.6*	*45.4*
Current increased compliance	15.1	84.9
Future increased compliance	*24.8*	*75.2*

Table 5.41 Factors which may negatively impact upon willingness to adopt SEHRs

Would the following influence your willingness to adopt SEHRs?	**Yes**	**No**
Current increased workloads	45.2	54.8
Future increased workloads	*68.7*	*31.3*
Current decreased care provider privacy	29.0	71.0
Future decreased care provider privacy	*46.1*	*53.9*
Current decreased patient privacy	34.4	65.6
Future decreased patient privacy	*52.7*	*47.3*
Current increased admin costs	35.1	64.9
Future increased admin costs	*54.5*	*45.5*
Current decreased satisfaction	25.6	74.4
Future decreased satisfaction	*42.4*	*57.6*
Current decreased care	32.5	67.5
Future decreased care	*51.2*	*48.8*
Current increased complexity	41.4	58.6
Future increased complexity	*65.2*	*34.8*
Current decreased compliance	17.0	83.0
Future decreased compliance	*27.4*	*72.6*

Tables 5.40 and 5.41 reveal a number of interesting factors. Firstly, the top three factors which would positively influence care providers willingness to adopt SEHRs were:

- Future/current improved care (71.4/42.5%);
- Future/current decreased workloads (59.2/37.6%); and
- Future/current reduced complexity (54.6/31.7%).

The top three factors identified by respondents' which would negatively influence their willingness to adopt SEHRs were:

- Future/current increased workloads (68.7/45.2%);
- Future/current increased complexity (65.2/41.4%); and
- Future/current increased admin costs (54.4/35.1%).

Two of the three top factors are consistent in both lists – workloads and complexity. These identified factors are also consistent throughout the findings of the survey towards technology in general, illustrating the link between willingness to adopt technology and SEHRs. The issues identified by care providers' in the above lists are those which need to be focussed on during implementation of SEHRs to improve care providers' willingness to adopt.

Two of the above issues – complexity and workloads - are among the top two factors targeted by care providers in the final component of the survey which asked respondents to identify what they perceive as the most important advantages and disadvantages of SEHRs. These two factors are also consistent with two of the factors used to test this study's research question (perceived complexity and perceived relative advantage (through reduced workloads)).

In addition to the factors identified above, a number of other elements commonly practiced during the daily role of a care provider were listed. Respondents were asked to specify their perception as to how SEHRs would impact on these processes. If respondents believed that SEHRs would impact these processes, respondents were asked to indicate whether that would in turn influence their willingness to adopt. Respondents' indicated that SEHRs have the potential to influence the following daily processes:

- Positively improving communication with other care providers;
- Positively impacting upon facilitation of legal defence;
- Negatively adding to administrative work commitments;
- Negatively impacting upon compatibility with existing doctor/patient values;
- Negatively creating difficulties meeting legislative requirements;
- Positively impacting upon time spent with patients; and
- Positively creating a competitive advantage (in terms of funding/patient care).

Of the issues listed, the following were identified by respondents as having the greatest impact upon their willingness to adopt:

- Positively improving communication between other care providers (80.8%);
- The potential to increase time spent with patients (76.6%);
- Negatively adding to work commitments (66.8%); and

- Incompatibility with existing values (64.6%).

These results are consistent with the main variables tested in this research i.e. relative advantage, compatibility and complexity.

Respondents' were then asked to identify areas in which their organisation could gain an advantage if they implemented SEHRs (Table 5.42).

Table 5.42 Areas of competitive advantage possibly gained from SEHRs

Advantage area	Percentage
Collaboration with other care providers	38.9
Quality of patient care	32.9
Timeliness of patient care	28.5
Collaboration with related organisations	25.7
Personal workloads	18.0

Based on the information gathered in this section of the survey, respondents were finally asked to identify the attributes which they perceived as most important for a SEHR system (Table 5.43).

Table 5.43 Most important attributes of a SEHR system

Advantage area	Percentage
Ease of use	79.9
Usefulness to care providers	70.5
Compatibility with existing values	51.5
Ease of collaboration	50.8
Relative advantage	45.9
Individual patient trust	39.8
Public image	26.1

The most important attributes of a SEHR system as identified by care providers in Table 5.43 are again consistent with the primary variables tested in this study, i.e. relative advantage, compatibility and complexity.

The survey concluded with two open-ended questions asking respondents' to identify what they perceived as (a) the main potential benefit of SEHRs compared to current systems for patient records (Table 5.44) and (b) the main potential problem associated with SEHR compared to current systems for patient records (Table 5.45).

Table 5.44 Perceived main benefit of SEHRs compared to current patient record systems

Privacy impact	Frequency
Ease of access/availability to complete patient information/medical history	106
Examine past treatments/investigations resulting in less duplication	71
Sharing/viewing of other clinicians information in a timely manner	56
Improved patient care/outcomes	47
Improved communication between patients/other care providers	37
Improved accuracy of data	18
Collection of patient data more effectively	9
None	49
Other	14

Table 5.45 Perceived main problems associated with SEHRs compared to current patient record systems

Privacy impact	Frequency
Access controls/ privacy issues/ loss of confidentiality between doctor patient relationship/data	150
Complexity of system – integration and operation/ increased workload/ extra administrative burden/ bureaucracy	95
Maintaining accuracy/timely info	43
Acceptance by care providers/community/administration	31
Universal adoption/compatibility	29
Need for alternative access/power down strategies	25
Costs	17
Miss visual patient cues	17
Legal	13
No need for change	8
None	6
Other	7

As illustrated by the above tables, respondents' identified more problems than benefits associated with SEHRs. These problems related to issues identified previously through data collection – complexity and workload issues. The main benefits are also consistent with previous findings through preliminary data analysis, in that respondents' identified ease of access/availability of information and collaboration with other care providers as the main benefits of SEHRs.

5.6 Conclusion

A total of 588 valid responses were received from currently active care providers registered with the Australian Medical Association of Queensland (AMAQ) for the study (valid response rate of 11.73%). The majority of respondents (36.4%) indicated that their principal role was that of a Specialist. The Brisbane City region had the greatest representation of the 14 distinct demographic areas identified by the AMAQ (25.3%). Approximately half of all respondents operated within the private sector.

A number of issues related to technology, specifically respondents' general attitudes towards the use of technology within their roles as care providers were examined. The majority of care providers' (79.2%) indicated a large to very large change in the level of technology change over the past five years. Factors which care providers' identified as greatly influencing their acceptance of technology included ease of use; providing continuity of patient care; and improving quality of patient care. When asked to identify whether technology had the *potential* to provide benefit or *actually* provided benefit throughout a number of identified areas, the overwhelming response was that technology has great potential to provide benefits, however to date has not fully realised its actual potential.

When respondents were asked about Commonwealth and State legislation relating to recordkeeping, and the subsequent management of patient information, approximately three-quarters of respondents (73.6%) indicated that they did not have an understanding of the relevant Commonwealth or State legislation. Care providers also indicated that increased privacy legislation has had a considerable impact on their work practices. Increased privacy legislation has meant that care providers' have had to improve documentation relating to patient information, while it has also made it more difficult to access records and contact relatives of patients.

Specifically relating to SEHRs, over half of the respondents (57.6%) were not aware of trials which have been conducted throughout Australia. However, of those aware of the trials, the majority indicated that the results of these trials would not influence their willingness to adopt SEHRs (82.6%). Generally, respondents were more willing to adopt SEHRs in the future (72%) rather than currently (63.5%). The factors identified which would most positively influence care providers' willingness to adopt SEHRs related to improved patient care, reduced workloads and reduced complexity. The main problems identified by care providers relating to implementation of SEHRs included privacy/complexity and compliance issues.

Overall, based on an assessment of general attitudes towards technology and SEHRs, the majority of respondents could be assumed as having a positive attitude towards the use of technology for general day to day use, and also for patient care. However, care providers indicated that the expected benefits of technology have not typically been realised to date. Shared electronic health records divided opinion, with the majority of respondents indicating some level of degree of willingness to adopt and implement SEHRs, provided various potential benefits were realised. Based on care provider perceptions of a SEHR system such as HealthConnect/PCEHR, the biggest challenge to overcome would appear to be the critical issues of complexity and factors relating to relative advantage such as workloads, and demonstrating the ability of SEHRs to achieve stated benefits.

The following chapter employs statistical methods such as Categorical Principal Component Analysis and regression to analyse the data overviewed in this chapter in order to test the research hypotheses proposed in this study.

CHAPTER 6 – DATA ANALYSIS

The previous chapter provided an overview of the data gained from the Shared Electronic Health Records survey. The data primarily consisted of care provider demographics, respondents' perceptions of technology, patient care, compliance and shared electronic health records (SEHRs). This chapter tests the hypotheses presented in Chapter Four and provides a discussion relating to the hypothesis tests.

6.1 Data Preparation

All quantitative data from the questionnaire was entered into an SPSS data file. Prior to any analysis, variables were recoded for consistency and applicability. As outlined in Chapter 4, the data obtained from the survey is a mixture of both parametric and nonparametric. Nonparametric statistical procedures typically use nominal or ordinal-scaled data and make no assumptions about the distribution of the population (Zikmund 2003).

The data was entered into SPSS, and was checked for accuracy by running frequency distributions and any out of range values were checked. SPSS was used to check for missing values. The percentage of missing values for all variables was less than 10%. Missing vales on a variable were handled by using functionality inbuilt in the CATPCA analysis process to impute the mode value.

In order to check for outliers in the data, SPSS was used to generate frequencies and histograms. Whilst some cases showed the presence of outliers, none were deemed to be inconsistent and therefore all were retained in the analysis.

As outlined in Chapter 4, prior to any analysis, variables were recoded for consistency and applicability. All nominal scaled questions were recoded so as a negative response was assigned a '1' and a positive response was assigned '2' for consistency in interpretation. Responses to interval scale questions such as those measured on a 5-point Likert scale were recoded so as the positive responses were assigned a higher number compared to negative responses. For example, 'Very poorly' was recoded as a '1', 'Poorly' recoded as '2', 'Adequate' remained as '3', 'Very well' was recoded as '4', 'Excellent' recoded as '5'.

It was considered appropriate (based on the literature) to apply parametric testing procedures on the 5-point Likert scale in which this hypothesis is based. A review of the literature found that Likert scales are commonly treated as interval data for testing purposes, even though the data is ordinal in nature (Goldstein & Hersen 1984; Jaccard & Wan 1996; Johnson; Shaughnessy & Zechmeister 1990; Sisson & Stocker 1989), facilitating parametric data analysis. The application of parametric tests to Likert scales has been validated by the fact that these tests do not affect Type I and Type II errors dramatically (Jaccard & Wan 1996). Results of the CATPCA and linear regression testing would indicate whether perceptions of those variables comprising Relative advantage, Compatibility and Complexity have significantly influenced care providers' future willingness to adopt SEHRs.

6.2 Hypotheses to be Tested

Hypothesis testing involved analysis to identify whether the factors of Relative advantage, Compatibility and Complexity influence care providers' future willingness to adopt shared electronic health records. Categorical Principal Component Analysis (CATPCA) was initially used for hypotheses one to three to identify the dimensions comprising Relative advantage, Compatibility and Complexity. Following the application of CATPCA on the variables comprising Relative advantage, Compatibility and Complexity, the first three hypotheses were then tested using regression analysis. Hypotheses four and five were tested using Chi-Square analysis.

The main hypotheses as presented in Chapter Four are:

H_1: That perceptions of the variables comprising relative advantage have the potential to influence willingness to adopt shared electronic health records;

H_2: That perceptions of the variables comprising compatibility with existing systems and practices have the potential to influence willingness to adopt shared electronic health records;

H_3: That perceptions of the variables comprising complexity have the potential to influence willingness to adopt shared electronic health records;

H_4: That willingness to adopt shared electronic health records varies across the three tiers of the health system within Queensland;

H_5: That willingness to adopt shared electronic health records varies across public and private sector health facilities within Queensland.

6.3 Statistical Methods

The questionnaire for this study consisted of nominal, ordinal and interval scales, to facilitate tests such as Chi-Square analysis to more detailed tests such as Categorical Principal Component Analysis (CATCPA) and multiple regression analysis. Categorical Principal Component Analysis was used as a pre-step to regression analysis to examine the component structure of the variables comprising Relative advantage, Compatibility and Complexity (Gifi 1990). This methodology was followed in this study due to the number of variables that could potentially influence Relative advantage, Compatibility and Complexity (refer sections 4.7.1 – 4.7.3).

As stated in Chapter 4, the goal of CATPCA is to reduce an original set of variables into a smaller set of uncorrelated components that represent most of the information found in the original variables. Categorical Principal Component Analysis simultaneously turns categorical variables into quantitative variables using optimal scaling and reduces the dimensionality of the data (Manisera et al. 2005). In addition, and of importance for this study, CATPCA allows analysis of complicated multivariate data, consisting of nominal, ordinal and numerical variables (Meulman et al. 2004), and is therefore suited for variables of mixed measurement level that may not be linearly related to each other (Manisera et al. 2010).

Multiple regression analysis was used to test for association between object scores (independent variables) generated by CATPCA and the dependent variable, future willingness to adopt SEHRs.

Chi-Square analysis was used to examine the strength of the association between collected data and the specified distribution. Specifically related to this study, Chi-Square tests are used to analyse any statistically significant difference in willingness to adopt SEHRs between the different tiers of the health system within Queensland, and to test for any statistically significant differences in willingness to adopt SEHRs between care providers from public and private sector health facilities within Queensland.

6.4 Results of Hypotheses Testing

6.4.1 Hypotheses One to Three

CATPCA testing

Categorical Principal Component Analysis was utilised to establish the component structure of the data prior to testing the first three hypotheses. Categorical Principal Component Analysis simultaneously quantifies categorical variables while reducing the dimensionality of the data. The CATPCA testing showed that Relative advantage, Compatibility and Complexity were each comprised of two dimensions. Following the application of CATPCA, the identified dimensions of Relative advantage, Compatibility and Complexity were then tested using regression analysis against the dependent variable, ‘Future willingness to adopt SEHRs’, which was measured on a 5-point Likert scale (with responses ranging from ‘Extremely against’ through to ‘Extremely willing’).

Optimal scaling for all variables identified as comprising Relative advantage, Compatibility and Complexity was set to ordinal in order to retain the ordering in the categories for these variables without making the assumption of equal intervals between category numbers. Since there is no need for linear transformations with the use of CATPCA (Noeverman 2007), the use of ordinal transformations allows more freedom in the analysis.

Initial CATPCA output for the variables comprising Relative advantage, Compatibility and Complexity was assessed with regard to (a) Cronbach’s α, and (b) component loadings, in order to assess the appropriateness of the findings. The model structure of data for the first three hypotheses is well represented, indicated by the high Cronbach’s α (greater than 0.7) in Table 6.1.

Table 6.1 Model summary of CATPCA analysis for the variables comprising Relative advantage, Compatibility and Complexity

		Variance Accounted For
Dimension	Cronbach's Alpha	Total (Eigenvalue)
Perceived benefits of technology	.898	7.663
Perceived advantages of SEHRs	.702	3.118
Total Relative Advantage	**.937**[a]	10.781
Perceived potential to improve communication between care providers	.791	3.761
Perceived compatibility of SEHRs with care providers’ values relating to patient care	.395	1.578
Total Compatibility	**.875**[a]	5.339

Perceptions of complexity relating to information and records management	.791	3.768
Perceptions of complexity relating to compliance	.379	1.543
Total Complexity	**.874**[a]	5.311

a. Total Cronbach's Alpha is based on the total Eigenvalue.

Following the review of the model structures above, CATPCA component loadings for all variables identified as comprising Relative advantage, Compatibility and Complexity (Table 4.1, 4.2 & 4.3) were reviewed. The review of component loadings aimed to identify only those variables with a component loading score above 0.4. Those variables with a component loading lower than 0.4 were discarded, and variables with a score of 0.4 or greater were included in a second round of CATPCA analysis. This process was undertaken to ensure only those variables with a clean loading would be used to determine whether the variables identified as comprising Relative advantage, Compatibility and Complexity had any statistically significant influence on a care provider’s future willingness to adopt SEHRs.

The results of the final round of CATPCA for the variables to be utilised in the first three hypotheses identified two distinct dimensions for each factor. Dimension one of Relative advantage could be considered to represent those variables consisting of the perceived advantages of technology in general. The variables comprising dimension one primarily relate to the questions from Section B of the questionnaire used for this research. Dimension two of Relative advantage is mainly explained by those variables identified as comprising perceived advantages of SEHRs. The variables comprising dimension two of Relative advantage relate to Section E of the questionnaire used for this research. Dimension two relates to perceptions of advantages of ‘future use’, as at the time of issuing the survey (2005), SEHRs had not been widely tested or implemented by Queensland’s care providers. Dimension one of Compatibility can be explained by those variables identified as comprising perceptions of potential improved communication between care providers. Dimension two of Compatibility was represented by the variables best explained as perceived compatibility of SEHRs with care providers' values relating to patient care. The first dimension of Complexity is explained by those variables identified as comprising perceptions of complexity relating to information and records information management. The second dimension of Complexity was represented by the variables that could be considered as representing the perceptions of complexity relating to compliance. Table 6.2 provides a summary of the heavily loaded variables following the second round of CATPCA (with a loading of 0.4 or greater) comprising each dimension of Relative advantage, Compatibility and Complexity.

Table 6.2 Variables and component loadings for each dimension of Relative advantage, Compatibility and Complexity

Items	Components					
	Relative advantage: **perceived advantages of technology in general**	Relative advantage: **perceived advantages of SEHRs**	Compatibility **Perceived potential to improve communication between care providers**	Compatibility **perceived compatibility of SEHRs with care providers' values relating to patient care**	Complexity **perceptions of complexity relating to information and records information management**	Complexity **perceptions of complexity relating to compliance**
Professional Autonomy (B5)	.461					
Continuity of Care (B8)	.406					
Quality of Care (B9)	.513					
Improves Performance (B10)	.487					
Actual Accessibility to patient history (B15aii)	.703					
Actual Improved accuracy (B15bii)	.736					
Actual Accessibility to Treatment and Support (B15cii)	.690					
Actual Reduced admin time (B15dii)	.701					
Actual Increased time effectiveness (B15eii)	.696					
Actual Elimination of errors (B15fii)	.761					
Actual Elimination of Surgery Errors (B15gii)	.699					
Actual Rapid delivery of results (B15hii)	.625					
Actual Improved provider satisfaction (B15iii)	.813					
Actual Improved patient satisfaction (B15jii)	.785					
Improves Outcomes (C1b)	.611					
Reduces error (C1d)	.521					
Future decreased workloads (E61ii)		.641				
Future improved care provider privacy (E62ii)		.715				
Future improved patient privacy (E63ii)		.723				
Future decreased admin costs (E64ii)		.663				

Items	Components					
	Relative advantage: **perceived advantages of technology in general**	Relative advantage: **perceived advantages of SEHRs**	Compatibility **Perceived potential to improve communication between care providers**	Compatibility **perceived compatibility of SEHRs with care providers' values relating to patient care**	Complexity **perceptions of complexity relating to information and records information management**	Complexity **perceptions of complexity relating to compliance**
Future improved satisfaction (E65ii)		.704				
Future improved care (E66ii)		.614				
Clinicians (B17a)			.876			
Caregivers (B17b)			.842			
Organisational Personnel (B17c)			.770			
Specialists (B17d)			.876			
Pharmacists (B17e)			.803			
Compatibility of SEHRs with existing values (E11)				.811		
SEHR potential to increase time with patients (E13i)				.768		
Gathering and keeping records (D6a)					.875	
Storage of information (D6b)					.906	
Reliability of information (D6c)					.880	
Protection of information (D6d)					.802	
Increased awareness of legislative requirements for patient records (D5a)						.452
Increased impact of privacy legislation (D5b)						.595
Increased impact of litigation (D5c)						.644
Impact of increasing media coverage (D7)						.522

Figure 6.1 to 6.3 represent a graphical display (plot of components) of the two dimensions of Relative advantage, Compatibility and Complexity.

Figure 6.1 Plot component loadings for CATPCA variables comprising Relative Advantage

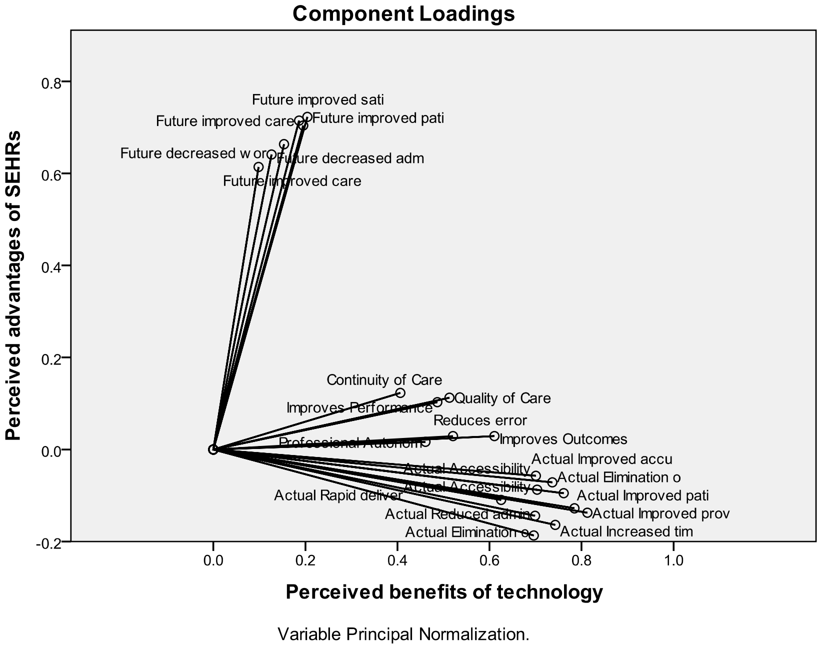


Figure 6.2 Plot component loadings for CATPCA variables comprising Compatibility

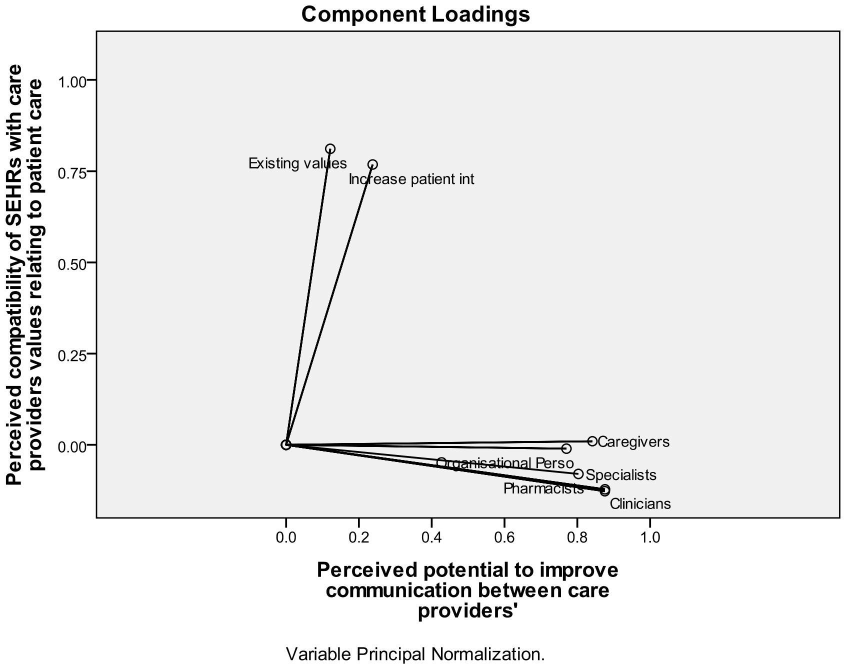
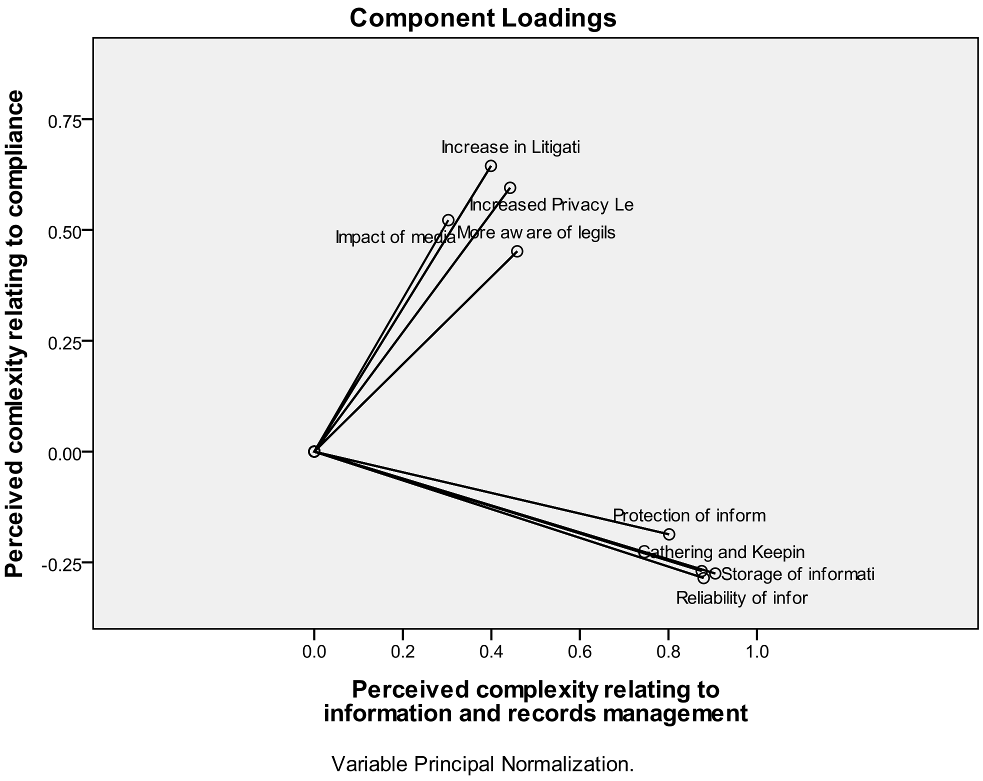


Figure 6.3 Plot component loadings for CATPCA variables comprising Complexity



The output from Figures 6.1 – 6.3 illustrates that the majority of variables for all dimensions of Relative advantage, Compatibility and Complexity contain positive component loadings. High positive component loadings (e.g. for dimension one and two of Relative advantage), potentially indicate that the variables comprising both dimension one (perceived benefits of technology) and two (perceived advantages of SEHRs) may have a significant correlation with improved future willingness to adopt SEHRs.

Following the CATPCA testing, component (or object) scores were generated for each dimension of Relative advantage, Compatibility and Complexity. These component scores were individually tested in regression analysis against the dependent variable 'Future willingness to adopt SEHRs' to determine any statistical significance of the dimensions identified as comprising Relative advantage, Compatibility and Complexity and their potential influence on a care providers' future willingness to adopt SEHRs.

Multiple Regression Analysis

The results of the multiple regression analysis for Relative advantage, Compatibility and Complexity (comprising both dimensions one and two) are shown in Table 6.3.

Table 6.3 Model summary for regression analysis – hypotheses one to three

Model Summary				
Dimension	R Square	Regression Coefficient (B)		Sig
Relative advantage	.108	Perceived benefits of technology	.334	.000
		Perceived advantages of SEHRs		
Compatibility	.239	Perceived potential to improve communication between care providers		.000
		Perceived compatibility of SEHRs with care providers values relating to patient care		
Complexity	.008	Perceived complexity relating to information and records management		.037
		Perceived complexity relating to compliance		

Relative Advantage

The value of R Square (10.8%) for Relative advantage was statistically significant (df = 2, 551; p = <.001). The regression model suggests that 10.8% of the variation in care providers' future willingness to adopt SEHRs could be explained from the variables comprising Relative advantage alone. Although the R Square value may be seemingly low (the large sample size can decrease the R Square value), it is still a statistically significant result, though some caution is needed when interpreting the results.

An examination of the beta coefficients showed that the variables comprising perceptions of the benefits of technology (Beta = .334; p = <.001) and perceptions of the advantages of SEHRs (Beta = .334; p = <.001) were significant predictors for care providers' future willingness to adopt SEHRs, indicating a positive linear relationship between Relative advantage and willingness to adopt.

When examining the individual dimensions of Relative advantage, both dimension one which incorporates the variables that can be best summarised as the perceived benefits of technology, and dimension two which incorporates the variables that can be best summarised as the perceived advantages of SEHRs were statistically significant (df = 1, 552; p = <.001). The regression model shown in Table 6.4 suggests that 8.6% of the variation in care providers' future willingness to adopt SEHRs could be explained from the variables comprising dimension one, and 2.1% of the variation in care providers' future willingness to adopt SEHRs could be explained from the variables comprising the perceived advantages of SEHRs (dimension two) of relative advantage. These findings however need to be interpreted with caution given the low R Square value.

Table 6.4 Comparison of regression analysis findings for dimension one and two of Relative advantage

Model Summary			
Dimension	R Square	Regression Coefficient (B)	Sig
Relative advantage Perceived benefits of technology	.086	.329	.000
Relative advantage Perceived advantages of SEHRs	.021	.162	.000

Compatibility

The value of R Square (23.9%) for Compatibility was statistically significant (df = 2, 551; p = <.001). The regression model suggests that 23.9% of the variation in care providers' future willingness to adopt SEHRs could be predicted from the variables comprising Compatibility alone. Similarly to the findings from the multiple regression analysis of Relative advantage, the results for Compatibility need to be interpreted with caution given the low R Square value.

An examination of the beta coefficients showed that the variables comprising perceived potential to improve communication between care providers (Beta = .501; p = <.001) and perceived compatibility of SEHRs with care providers values relating to patient care (Beta = .334; p = <.001) were significant predictors for care providers' future willingness to adopt SEHRs, indicating a positive linear relationship between Compatibility and willingness to adopt SEHRs.

An analysis of the individual dimensions of Compatibility found that both dimension one (which incorporates the variables that can be best summarised as perceptions of potential improved communication between care providers) and dimension two (perceived compatibility of SEHRs with care providers values relating to patient care) were statistically significant (df = 1, 552; p = <.001). The regression model in Table 6.5 suggests that 5% of the variation in care providers' future willingness to adopt SEHRs could be predicted from the variables comprising dimension one of compatibility. Dimension two is shown to account for 17.9% of the variation in care providers' future willingness to adopt SEHRs. Similarly to previous findings, the results need to be interpreted with caution given the low R Square values.

Table 6.5 Comparison of regression analysis findings for dimension one and two of Compatibility

Model Summary			
Dimension	R Square	Regression Coefficient (B)	Sig
Compatibility Perceived potential to improve communication between care providers	.050	.251	.000
Compatibility Perceived compatibility of SEHRs with care providers values relating to patient care	.179	.475	.000

Complexity

Although the regression model suggests that less than one percent of the variation in care providers' future willingness to adopt SEHRs could be explained from the variables comprising Complexity alone, the value of R Square (<1%) for Complexity was statistically significant (df = 2, 551; p = .037).

An examination of the beta coefficients showed that the variables comprising perceived complexity relating to compliance (Beta = .113; p = <.015) were statistically significant predictors for care providers' future willingness to adopt SEHRs. Perceived complexity relating to information and records management requirements was not a significant predictor (Beta = .006; p = .903).

Further examining of the individual dimensions of Complexity shows that just dimension two (which incorporates the variables that can be best summarised as the perception of complexity relating to compliance) was statistically significant (df = 1, 552; p = .015). The regression model shown in Table 6.5 suggests that 1% of the variation in care providers' future willingness to adopt SEHRs could be explained from the variables comprising dimension two of complexity. As with previous findings, the results need to be interpreted with caution given the low R Square values.

Table 6.6 Comparison of regression analysis findings for dimension one and two of Complexity

Model Summary			
Dimension	R Square	Regression Coefficient (B)	Sig
Complexity Perceived complexity relating to information and records management	.000	.006	.903
Complexity Perceived complexity relating to compliance	.010	.113	.015

Validity testing

A number of tests of the validity of the model for Relative advantage, Compatibility and Complexity were investigated as follows:

- The Durbin-Watson statistics (Table 6.7) for Relative advantage, Compatibility and Complexity indicated that there was no significant first-order serial correlation among the residuals (Zikmund 1991).

- A normal plot of regression standardised residuals for the dependent variable indicated a relatively normal distribution (Figures 6.4 and 6.5 show examples for Relative advantage and Compatibility.
- A scatterplot of residuals against predicted showed no clear relationship between residuals and predicted values consistent with the assumption of linearity (Coakes and Steed 1996).

Table 6.7 Durbin-Watson statistics for Relative advantage, Compatibility and Complexity

Variable	Durbin-Watson statistic
Relative advantage	2.134
Compatibility	2.082
Complexity	2.106

Figure 6.4 Regression standardized residuals for Relative advantage

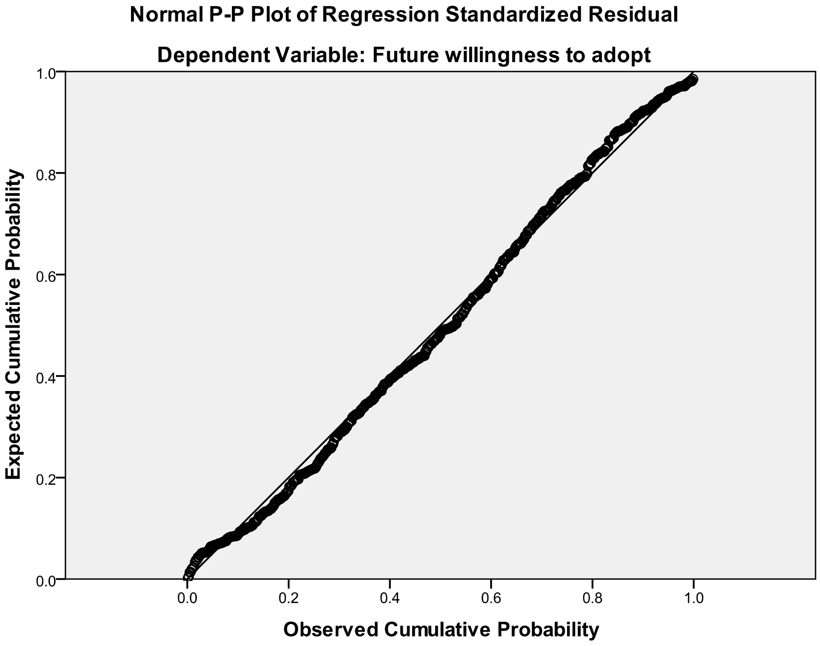
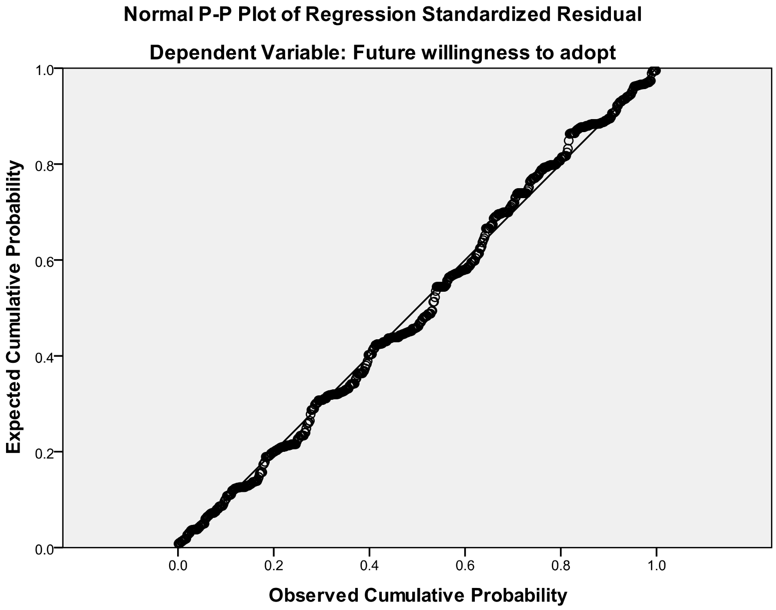


Figure 6.5 **Regression standardized residuals for Compatibility**



Summary of Relative advantage hypothesis testing

The data provided by Table 6.3 is sufficient to show that the variables best summarised as the perceived benefits of technology (dimension one) and the perceived advantages of SEHRs (dimension two) are statistically significant predictors at the $\alpha = .05$ level of significance of potential to influence care providers' future willingness to adopt SEHRs. While caution is needed given the low R Square, H_1 is supported (Table 6.8).

An analysis of the findings also revealed that the perceived benefits of technology (dimension one) had a greater potential influence on care providers' future willingness to adopt SEHRs compared to the perceived advantages of SEHRs.

Table 6.8 **Summary of hypothesis testing for Relative advantage**

Hypothesis		R Square	Df	F	Sig Level	Accept/ Reject
H_1	*That perceptions of the variables comprising relative advantage have the potential to influence willingness to adopt shared electronic health records*	.108	2,551	34.539	<.001	Accept

Summary of Compatibility hypothesis testing

The data provided by Table 6.3 is sufficient to show that the variables comprising Compatibility, summarised as perceived potential to improve communication between care providers (dimension one) and perceived compatibility of SEHRs with care providers' values relating to patient care (dimension two), are statistically significant predictors at the $\alpha = .05$ level of significance of potential to influence care providers' future willingness to adopt SEHRs. While caution is needed given the low R Square, H_2 is supported (Table 6.6).

Further analysis of the findings revealed that perceived compatibility of SEHRs with care providers' values relating to patient care (dimension two) had a greater potential influence on care providers' future willingness to adopt SEHRs compared to perceived potential to improve communication between care providers (dimension one).

Table 6.9 Summary of hypothesis testing for Compatibility

Hypothesis	R Square	Df	F	Sig Level	Accept/ Reject
H_2 *That perceptions of the variables comprising compatibility with existing systems and practices have the potential to influence willingness to adopt shared electronic health records*	.239	2,551	87.886	<.001	Accept

Summary of Complexity hypothesis testing

The data provided by Tables 6.3 is sufficient to show that the variables of Complexity summarised as the perceptions of complexity with information and records management (dimension one) and the perceptions complexity relating to compliance are statistically significant predictors at the $\alpha = .05$ level of significance of potential to influence care providers' future willingness to adopt SEHRs. While caution is needed given the low R Square, H_3 is supported (Table 6.10).

More detailed analysis of the findings revealed that the variables best described as perceptions of complexity relating to compliance (dimension two) had a greater influence on care providers' future willingness to adopt SEHRs compared to the perceptions of complexity relating to information and records management related variables (which were not statistically significant predictors of influence to care providers' willingness to adopt SEHRs.

Table 6.10 Summary of hypothesis testing for Complexity

Hypothesis	R Square	Df	F	Sig Level	Accept/ Reject
H_3 *That perceptions of the variables comprising complexity have the potential to influence willingness to adopt shared electronic health records*	.012	2,551	3.313	.037	Accept

6.4.2 Hypothesis Four

The fourth hypothesis tests:

H_4: *That willingness to adopt shared electronic health records varies across the three tiers of the health system within Queensland.*

As stated in Chapter Four, this hypothesis was tested using Chi-Square analysis. Chi-Square analysis was chosen to test for significant difference in future willingness to adopt SEHRs between the three independent groups of the health system (i.e. General Practitioners; Specialists; and Hospital staff) so as to examine the strength of the association between collected data and the specified distribution. The p-value is the probability of observing a Chi-square statistic at least as large as the one actually observed, given that there is no association between a variable of data occurring by chance (Zikmund 2003). Results of the Chi-Square test for hypothesis four are presented below in Table 6.11.

Table 6.11 Chi-Square Test on difference between different tiers of the health system and future willingness to adopt SEHRs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.275[a]	8	.001
N of Valid Cases	540		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.50.

The output in Table 6.8 shows that the value of chi-square (χ^2) = 27.275 and the degrees of freedom on which this was based, was 8. These results show that there is sufficient statistical evidence to indicate that willingness to adopt shared electronic heath records varies across the three tiers of the health system within Queensland, (χ^2= 27.275, df = 8, p=.001). Hence, there is sufficient statistical evidence to support hypothesis four.

These findings are further supported by output in Table 6.12 below:

Table 6.12 Difference between expected and actual findings between tiers of health system and future willingness to adopt SEHRs

Future willingness to adopt based on Health Tier

			Future willingness to adopt					
			Extremely against	Some concerns	Somewhat willing	Very willing	Extremely willing	Total
Role recoded	GP	Count	12	56	58	32	33	191
		Expected Count	9.6	44.6	60.1	40.3	36.4	191.0
	Specialist	Count	13	48	68	42	28	199
		Expected Count	10.0	46.4	62.6	42.0	38.0	199.0
	Hospital Staff	Count	2	22	44	40	42	150
		Expected Count	7.5	35.0	47.2	31.7	28.6	150.0
Total		Count	27	126	170	114	103	540
		Expected Count	27.0	126.0	170.0	114.0	103.0	540.0

Table 6.12 shows that the variation between actual count and expected count of care providers' future willingness to adopt SEHRs. For example, Hospital staff are over represented in the 'Extremely willing' category (expected 28.6 responses, however received 42 responses), and Specialists were under represented in this category (expected 38 however received 28 responses). Alternatively, of all the people who responded 'Extremely against' the highest percentage was Specialists (48.1%). Just 7.4% of respondents in the 'Hospital Staff' category identified as 'Extremely against' future willingness to adopt SEHRs. In all care provider categories 'Extremely against' was recorded the least. In GP and Specialist 'Some concerns' was higher than 'Very willing' and 'Extremely willing', but in Hospital staff it was less.

A comparison of means across the tiers of the health sector demonstrates that Hospital staff had the highest willingness to adopt, with a mean score of 3.65 (Table 6.13). Specialists had the next highest willingness to adopt, with a mean score of 3.12, and GPs had a mean score of 3.09.

Table 6.13 Comparison of mean willingness to adopt across the tiers of the health system

Role	Mean	N	Std. Deviation
GP	3.09	191	1.184
Specialist	3.12	199	1.126
Hospital Staff	3.65	150	1.081
Total	3.26	540	1.159

6.4.3 Hypothesis Five

The fifth hypothesis tests:

H_5: That willingness to adopt shared electronic health records varies across public and private sector health facilities within Queensland.

As stated in Chapter Five, this hypothesis was tested using Chi-Square analysis to test for any statistically significant results relating to willingness to adopt SEHRs between public and private sector health facilities within Queensland. The Chi-Square analysis test assumes that there is no significant difference between the expected and the observed results (Garson 2009). Results of the Chi-Square test for hypothesis five are presented below in Table 6.14.

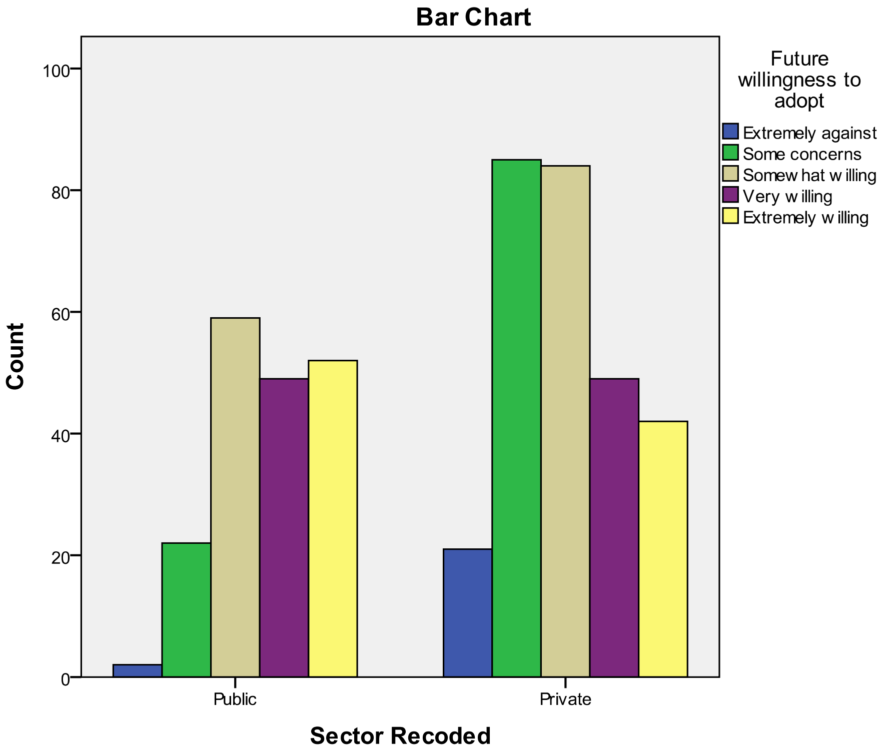
Table 6.14 Chi-Square Test on difference between public and private sectors for future willingness to adopt SEHRs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.717[a]	4	.000
N of Valid Cases	465		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.10.

The output in Table 6.14 shows the value of chi-square (χ^2) = 39.717 and the degrees of freedom on which this was based, was 4. These results show that there is sufficient statistical evidence to indicate that willingness to adopt SEHRs with the sector the care provider works in within Queensland, (χ^2= 39.717, df = 4, p=.000). Hence, there is sufficient statistical evidence to support hypothesis five. Figure 6.6 below provides a graphical representation of the public and private sectors future willingness to adopt SEHRs.

Figure 6.6 Bar chart illustrating difference between public and private sector future willingness to adopt SEHRs



In both the public and private sectors, 'Extremely against' was recorded the least. Within the private sector, 'Some concerns' was higher than 'Somewhat willing', 'Very willing' and 'Extremely willing', but in public sector respondents, it was less. Public sector respondents were over represented in the 'Extremely willing' category, with 52 actual responses (compared to the expected total of 37.2. The greatest difference existed within the 'Extremely against' category, where 91.3% of the responses consisted of private sector respondents.

A comparison of mean scores for future willingness to adopt between the public and private sector (Table 6.15) finds that the public sector has a greater willingness to adopt SEHRs, with a mean score of 3.69 (compared to 3.02 for the private sector).

Table 6.15 Comparison of mean willingness to adopt between public and private sector

Sector Recoded	Mean	N	Std. Deviation
Public	3.69	184	1.044
Private	3.02	281	1.174
Total	3.29	465	1.170

6.5 Limitations

Results of the first three hypothesis provided limited predictive power (through the low R Square values) regarding the potential for the variables comprising Relative advantage, Compatibility and Complexity to influence care providers' willingness to adopt SEHRs. These results could be considered somewhat unexpected given the findings from the literature review, where a number of benefits of SEHRs associated with Relative advantage, Compatibility and Complexity were identified. These unexpected results could potentially be explained by (a) the timing of the survey and (b) statistical testing methods.

The questionnaire for this study was administered in 2005. As stated in Chapter Three, this was before any widespread trialling (or implementation) of SEHRs had commenced within Australia. As a consequence, it is likely that the responding Australian Medical Association Queensland (AMAQ) registered health care providers may have had a limited understanding of SEHRs. Because of the potential for limited understanding, respondents may not have been able to provide valid perceptions of the Relative advantage, Compatibility and Complexity aspects of adopting SEHRs. Given that the findings of the study are not what the literature suggested, the study may have been ambitious given the possible restrictions (e.g. potentially as a result of the limited experience of care providers' with SEHRs at the time of survey administration) related to care providers' offering data on perceptions relating to the various aspects of SEHRs. Given the planned implementation of the personally controlled electronic health record (PCEHR) system in Australia in July 2012, it would be recommended that an adapted version of the survey be run again to assist in developing policy and procedures for the implementation of SEHR's and to encourage willingness to adopt.

In addition to possible limitations related to the timing of questionnaire administration, the statistical techniques employed in this study (CATPCA and multiple regression) may have also contributed to the unexpected findings, by not being able to sufficiently assess the impact of the independent variables (Relative advantage, Compatibility and Complexity) on willingness to adopt. To identify whether the strength of the findings could be improved, logistic regression was undertaken for each of the independent variables. Logistic regression was chosen given the potential advantages of this statistical technique, specifically in the context of this study i.e. logistic regression is well suited for describing and testing hypotheses about relationships between a categorical outcome variable and one or more categorical or continuous predictor variables, and logistic regression creates estimates for the likelihood that an event occurs, given a set of conditions (Peng et al. 2002; Sweet and Grace-Martin, 2010).

Logistic regression analysis (utilising Backward LR stepwise) was conducted to assess the potential influence of each of the potential factors (Relative advantage, Compatibility and Complexity) upon the dependent variable, willingness to adopt. The same independent variables that were used to test $H_{1,}$ H_2 and H_3 were again used in this analysis. Results of the logistic regression analysis are identified in Table 6.16.

Table 6.16 Logistic regression model summary for Relative advantage

	Chi-square	df	Sig	Nagelkerke's R Square	Hosmer and Lemeshow Test
Relative Advantage	145.075	11	<.000	.465	.332
Compatibility	120.641	7	<.000	.334	.086
Complexity	23.119	2	<.000	.107	.635

The logistic regression found that the models for Relative advantage, Compatibility and Complexity were all statistically significant (Table 6.16), indicating that the variables comprising Relative advantage, Compatibility and Complexity influenced care providers' future willingness to adopt SEHRs. The Nagelkerke's R Square for Relative advantage and Compatibility and Complexity indicated a moderately strong relationship between prediction and grouping.

The Wald criterion identified the following variables which were a statistically significant predictor of care providers' future willingness to adopt SEHRs (Table 6.17).

Table 6.17 Wald criterion demonstrating significant variables influencing Relative advantage

Factor	Variable	Wald	Sig	Exp(B)
Relative advantage	Managerial Control (B7)	4.393	.036	1.932
	Quality of Care (B9)	9.272	.002	.268
	Future Decreased Workloads (E61)	7.616	.006	.405
	Future Improved Patient Privacy (E63)	12.743	.000	3.468
	SEHR Communication (E8)	33.990	.000	.120
	SEHR Legal Defence (E9)	19.070	.000	.195
	Actual Elimination of errors (B15fii)	11.254	.024	3.087
Complexity	Input into Technology Usage (B3)	5.848	.016	1.830
	SEHR to Add to Work Commitments (E10)	6.368	.012	2.496
	Compatibility of SEHRs with Existing Values (E11)	23.779	.000	.292
	SEHR potential to Increase Time with Patients (E13i)	12.330	.000	.378
	SEHR Potential to Limit Interaction with Patients (E13ii)	9.422	.002	3.200
	Level of technology change (B1)	6.239	.012	1.509
Compatibility	SEHRs to Meet Legislative Requirements (E12i)	18.121	.000	3.283
	Impact of increasing media coverage (D7)	3.960	.047	1.244

The findings from the logistic regression analysis are somewhat consistent with the earlier results of hypothesis H_1, H_2 and H_3, in that Relative advantage, Compatibility and Complexity were all found to be statistically significant predictors to potentially influence care providers' future willingness to adopt SEHRs. The logistic regression does however provide a stronger relationship between the potential of Relative advantage, Compatibility and Complexity to influence care providers' future willingness to adopt SEHRs.

6.6 Conclusion

This chapter initially outlined data preparation and cleansing methods to ensure that the data from the study's self administered questionnaire were accurately entered for analysis.

The study's primary hypothesis testing techniques were then reviewed, specifically relating the use of CATPCA, regression and Chi-Square analysis to care providers' future willingness to adopt SEHRs.

The next section of this Chapter then analysed whether the variables comprising the factors Relative advantage, Compatibility with existing systems and practices, and Complexity had impacted upon care providers' future willingness to adopt SEHRs. For each of the three factors, CATPCA was initially used to reduce the number of variables and to build the relevant dimensions. Multiple regression analysis was then used to test whether Relative advantage had the potential to provide a statistically significant influence on care providers' future willingness to adopt SEHRs.

Findings revealed that Relative advantage had a statistically significant potential to influence care providers' future willingness to adopt SEHRs. Additionally, dimension one (perceived benefits of technology) was found to have a greater potential to influence care providers' future willingness to adopt SEHRs compared to the variables comprising dimension two (perceived advantages of SEHRs) of Relative advantage.

Multiple regression analysis for Compatibility found that this factor had the potential to have a statistically significant influence on care providers' future willingness to adopt SEHRs. Of the two dimensions comprising Compatibility, dimension two (perceived compatibility of SEHRs with care providers' values relating to patient care) had a greater potential to influence willingness to adopt compared to the variables best described as perceived potential to improve communication between care providers (dimension one).

Multiple regression analysis found that Complexity also had the potential to have a statistically significant influence on care providers' future willingness to adopt SEHRs. Of the two dimensions comprising Complexity (perceptions of complexity relating to information and records management considerations and perceptions of the complexity relating to compliance), only dimension two produced statistically significant results.

Following the testing of hypotheses one to three, the data was then analysed to determine whether any variation existed between the three tiers of the health system within Queensland future willingness to adopt SEHRs (i.e. GPs, Specialists and Hospital staff). Findings revealed that there was a statistically significant variation at the $\alpha = 0.05$ level in future willingness to adopt SEHRs across the three tiers, therefore supporting null hypothesis four. Responses indicate that overall, Hospital staff were more willing to adopt SEHRs with GP's the least willing based on a comparison of responses to 'Extremely willing' and 'Very willing'.

Finally, variation to future willingness to adopt SEHRs between the public and private sector was investigated in hypothesis five. The data revealed that there was sufficient evidence to support the null hypotheses at the $\alpha = 0.05$ level, indicating that a statistically significant variation existed between the public and private sector's future willingness to adopt SEHRs. While both the public and private sector featured similar response rates to 'Extremely willing' or 'Very willing' to adopt

SEHRs in the future, the private sector contained a much greater number or respondents who were not willing to adopt (with responses to ‘Extremely against’ or ‘Some concerns’) compared to similar responses from public sector respondents.

Following the data analysis for the study’s hypotheses, potential limitations were then addressed. Potential limitations were identified in two key areas, (a) the timing of the survey and (b) statistical testing methods. The timing of the study was identified as a potential limitation because it was likely that the respondents to the study had a limited knowledge of SEHRs (due to limited trials or implementation throughout Queensland, and Australia), which meant that the results did not correspond with findings from the literature review. The statistical testing methods posed potential limitations as the impact of Relative advantage, Compatibility and Complexity on willingness to adopt was not clear. Subsequently, logistic regression was used to identify whether the strength of the findings could be improved. Results of the logistic regression were consistent with previous testing (i.e. that Relative advantage, Compatibility and Complexity had the potential to be statistically significant predictors of care providers’ future willingness to adopt SEHRs), and provided improved results relating to the strength of the relationships.

A discussion of results of the data analysis, the implications of those results, limitations of the research and recommendations for further research will be provided in Chapter Seven.

CHAPTER 7 - CONCLUSIONS

This chapter presents an overview of the study, the methodology used, a summary and discussion of the findings of the study, and the implications of these findings. Limitations of the research and recommendations for further research are then provided.

7.1 Overview of the study

This study sought to investigate three key factors which may impact upon care providers' future willingness to adopt shared electronic health records (SEHRs) i.e. care providers' perceptions of relative advantage, care providers' perceptions of compatibility with existing values, systems and practices, and care providers' concerns about complexity. The study employs an adaptation of Rogers' (1995) Diffusion of Innovation (DOI) theory.

Despite the benefits of SEHRs, their widespread implementation has been extremely slow to date. Previous implementation attempts have been ad hoc, and have not adequately addressed key care provider and patient concerns such as those dealing with privacy and infrastructure requirements. Being able to identify factors which may explain the slow uptake of SEHRs could be considered highly desirable, both within and beyond the concept of SEHRs. By targeting those factors which may influence willingness to adopt, the adoption process could become a more efficient process targeted to address the concerns of the adopters.

To gain a deeper understanding of the issues involved and to explore the study's research questions fully, the quantitative phase of the research involved a self administered questionnaire involving all active Australian Medical Association Queensland (AMAQ) registered health care providers from the public and private sector. The goal of the questionnaire was to identify from a care providers' perspective, factors which have the most significant impact upon future willingness to adopt SEHRs. The questionnaire was sent to currently active health care providers registered with the AMAQ. This population consisted of approximately 5013 care providers, located throughout Queensland. A total of 588 valid responses were received.

Objectives of this study were to:

- Use Diffusion of Innovation as developed by Rogers (1995) as the theoretical background for the research;
- Identify whether care providers' perceptions of relative advantage influence their willingness to adopt SEHRs;
- Identify whether care providers' perceptions of compatibility with current systems and practices influence their willingness to adopt SEHRs;
- Identify whether care providers' perceptions of the complexity associated with SEHRs influence their willingness to adopt SEHRs;
- Identify any differences in willingness to adopt SEHRs by care providers across the tiers and sectors of care providers within Queensland.

The study aims to determine the factors likely to have the greatest influence upon care providers' willingness to adopt SEHRs. This thesis addressed the overriding research question of: *Whether the factors of relative advantage, compatibility and complexity influence care providers' willingness to adopt shared electronic health records.*

This overriding research question was then subdivided into a number of hypotheses:

H_1: That perceptions of the variables comprising relative advantage have the potential to influence willingness to adopt shared electronic health records;

H_2: That perceptions of the variables comprising compatibility with existing systems and practices have the potential to influence willingness to adopt shared electronic health records;

H_3: That perceptions of the variables comprising complexity have the potential to influence willingness to adopt shared electronic health records;

H_4: That willingness to adopt shared electronic health records varies across the three tiers of the health system within Queensland;

H_5: That willingness to adopt shared electronic health records varies across public and private sector health facilities within Queensland.

Statistical techniques such as Categorical Principal Component Analysis (CATPCA), multiple regression and Chi-Square testing were used to test the hypotheses.

It is intended that the study makes both an applied contribution in providing a basis for developing policies to improve care providers' willingness to adopt SEHRs as well as a theoretical contribution to the literature. The study provides applied value in that it identifies from the point of view of a care provider, the factors that have the most statistically significant influence on their future willingness to adopt SEHRs. In addition to the identification of overall factors which have the greatest potential for influencing willingness to adopt SEHRs (i.e. Relative advantage; Compatibility and Complexity), the specific variables comprising each of these factors were also established. The identification of the factors likely to impact upon willingness to adopt could have significant potential for policy makers, for both SEHRs and other technological innovations.

7.2 Summary of Findings

To establish whether the variables comprising relative advantage, compatibility and complexity influenced care providers future willingness to adopt SEHRs, CAPTCA and multiple regression analysis were used. The main advantages of using CATPCA are that (a) it takes into account the categorical (ordinal) nature of the variables in the study; (b) it has different strategies for handling missing values; and (c) it enables multiple variables to be examined to see whether they influenced care providers' future willingness to adopt SEHRs (Manisera et al. 2005). Multiple regression was used to determine the statistical significance of the variables influencing willingness to adopt.

Additional testing was performed to determine whether any statistically significant difference existed in future willingness to adopt SEHRs between the three tiers of the health system in Queensland, and between the public and private sector in Queensland.

7.2.1 Overview of respondent demographics

Five hundred and eighty-eight valid responses were received to the questionnaire. A valid response was one which had been returned from a currently active care provider registered with the Australian Medical Association of Queensland (AMAQ).

Two hundred and fourteen respondents indicated that their principal role was that of a Specialist; 202 operated as a General Practitioner; 101 described their role as that of Resident or Registrar; 43 were a Salaried Specialist and 16 respondents indicated that their primary role as a care provider was acting as a Senior Medical Officer.

Almost half of the respondents (293) indicated that they operated within the Private sector. One hundred and ninety seven respondents indicated that they operated solely within the Public sector, and 97 respondents operated within both the public and private sectors.

The majority of respondents (244) indicated that they operated within a large hospital, and 279 indicated that they worked within a Hospital/Medical Care environment. One hundred and fifty-seven respondents identified as working within Group Practice.

7.2.2 Relative advantage and future willingness to adopt SEHRs

Hypothesis one was tested in two stages. The first stage of testing involved applying Categorical Principal Component Analysis (CATPCA) to the variables identified as best meeting the definition of relative advantage in the context of this study. This analysis identified that the component structure of the variables comprising Relative advantage could be summarised by two distinct dimensions – (a) perceived benefits of technology in general and (b) perceived advantages of SEHRs.

Multiple regression analysis was undertaken on the two dimensions comprising Relative advantage to test their statistical significance against the dependent variable, willingness to adopt. This identified whether the dimensions of Relative advantage (i.e. perceived benefits of technology in general and perceived advantages of SEHRs) had a statistically significant influence on care providers' future willingness to adopt SEHRs.

Results of the hypothesis testing found that the variables comprising Relative advantage had the potential to influence care providers willingness to adopt SEHRs, and that the perceived benefits of technology in general had a more statistically significant influence compared to the perceived advantages of SEHRs. These findings (i.e. that the variables comprising Relative advantage have the potential to influence care providers' future willingness to adopt SEHRs) appear consistent with findings from the literature review, given that the main variables influencing future willingness to adopt include variables which contribute to improvements to patient treatment and improvements to care provider performance.

Building upon findings from previous studies such as the 2004 Capgemini survey summarised in Chapter Three, this study has identified from the perspective of the care provider, specific components comprising relative advantage which contribute most to care providers' willingness to adopt SEHRs. The components of relative advantage identified by care providers' as contributing the greatest to willingness to adopt include accessibility to patient history; improved accuracy of information; reduced administrative time; elimination of errors; care provider satisfaction; and improved privacy for both the patient and the care provider.

The Personally Controlled Electronic Health Records (PCEHR) Concept of Operations, released in September 2011, further supports these findings, outlining a number of benefits related to the variables identified in this study as comprising Relative advantage. Stated benefits of a SEHR system within the Concept of Operations document includes improved continuity of care, improved access to information for care providers, improved diagnostic and treatment capabilities and the overall delivery of more effective healthcare (Commonwealth Department of Health and Ageing 2011).

7.2.3 Compatibility and future willingness to adopt SEHRs

Similarly to hypothesis one, testing of hypothesis two was undertaken in two stages. Categorical Principal Component Analysis was initially used to identify the most influential variables identified as comprising Compatibility, as defined in the context of this study. Similarly to hypothesis one, this analysis identified found that the component structure of the variables comprising Compatibility could be defined in two distinct dimensions – (a) perceived potential to improve communication between care providers' and (b) perceived compatibility of SEHRs with care providers' values relating to patient care.

Multiple regression was then used to identify whether the dimensions comprising Compatibility (i.e. perceptions of potential to improve communication between care providers' and perceived compatibility of SEHRs with care providers values relating to patient care) had a statistically significant influence on care providers' future willingness to adopt SEHRs.

Findings from the multiple regression identified that the variables comprising Compatibility had a statistically significant potential to influence care providers' future willingness to adopt SEHRs. Of the two dimensions comprising Compatibility, the variables comprising dimension two (i.e. perceived of compatibility of SEHRs with care providers values relating to patient care) produced a greater level of statistically significant influence on willingness to adopt SEHRs compared to the variables best explained as perceived potential to improve communication between care providers' (dimension one).

As with the findings for Relative advantage, this research has been able to build upon the findings from the literature review, and identify those components of Compatibility which have the greatest potential to influence care providers' willingness to adopt SEHRs. These variables include the compatibility of SEHRs with existing care provider values, and the potential to improve communication between a number of croups of care provider's such as clinicians, caregivers and specialists.

Similarly to the findings for Relative advantage, the findings that the variables comprising Compatibility have the potential to influence care provider willingness to adopt is again consistent with the findings from the literature review. Indeed, within the PCEHR System Concept of Operations (Commonwealth Department of Health and Ageing 2011), it is stated that one of the aims of the implementation of such a system is to improve clinical communications between care providers (e.g. between GPs and private specialists).

7.2.4 Complexity and future willingness to adopt SEHRs

As with the first two hypotheses, the same testing format was used for hypothesis three. Categorical Principal Component Analysis was initially used to identify the most influential variables identified as comprising Complexity, as defined in the context of this study. Analysis found that the component structure of Complexity consisted of two distinct dimensions – (a) perceptions of complexity relating to information and records management and (b) perceptions of complexity relating to compliance.

The dimensions comprising Complexity were then tested using multiple regression analysis against the dependent variable future willingness to adopt. This testing would identify whether perceptions of complexity relating to compliance and the perceptions of complexity relating to information and records management considerations had a statistically significant influence on care providers' future willingness to adopt SEHRs.

Through the process of hypothesis testing, findings revealed that the variables comprising Complexity had a statistically significant potential to influence care providers' future willingness to adopt SEHRs. Further analysis revealed that only the perceptions of complexity relating to compliance (dimension two) had a statistically significant influence on care providers' future willingness to adopt SEHRs.

The need to address the challenges related to compliance is supported by the PCEHR Concept of Operations, which states that the implementation and adoption of a national PCEHR System addresses a current challenge faced by the Australian health system — the fragmentation of information spread across a vast number of different locations, systems and legislative and regulatory environments (Commonwealth Department of Health and Ageing 2011). The findings of this study support the statements made within the PCEHR Concept of Operations, with the impact of litigation and increased privacy legislation identified as two of the specific factors which are impacting upon the daily practices of care provider's. A system that would provide the necessary infrastructure, standards and specifications to meet the relevant legislative and regulatory challenges related to litigation and information privacy is clearly important to care providers', and among the primary factors related to Complexity influencing future willingness to adopt SEHRs.

7.2.5 Variation in willingness to adopt SEHRs between tiers of the health system

Testing of hypothesis four involved significance testing through use of Chi-Square analysis to test for any statistically significant differences relating to willingness to adopt SEHRs between the levels of care providers' within Queensland (i.e. GPs, Specialists and Hospital staff).

Results of testing found that there was a statistically significant difference between future willingness to adopt SEHRs between the tiers of the health system. The highest percentage of respondents indicating that they were 'Extremely willing' to adopt SEHRs in the future were hospital staff. The mean score for future willingness to adopt across Hospital staff was 3.65, compared to 3.12 for Specialists and 3.09 for GPs. In all categories 'Extremely against' was recorded the least. In GP and Specialist 'Some concerns' was higher than 'Very willing' and 'Extremely willing', but in Hospital staff it was less.

7.2.6 Variation in willingness to adopt SEHRs between public and private sectors

As with hypothesis four, hypothesis five involved significance testing through use of Chi-Square analysis to test for any statistically significant differences in future willingness to adopt SEHRs between the public and private sector within Queensland.

Results of the hypothesis testing found that a statistically significant difference existed in future willingness to adopt SEHRs between the public and private sector in Queensland. The public sector had a mean score for future willingness to adopt SEHRs of 3.69 compared to a mean of 3.02 for the private sector. Overall, in both the public and private sectors, ‘Extremely against’ was recorded the least. Within the private sector, ‘Some concerns’ was higher than ‘Somewhat willing’, ‘Very willing’ and ‘Extremely willing’, but in public sector respondents, it was less.

7.3 Implications and Recommendations for Further Research

If policymakers, insurers and care quality advocates wish to *effectively* accelerate care providers’ willingness to adopt SEHRs, they may need to change the ways in which SEHRs are marketed and trialled to be more consistent with the beliefs and attitudes expressed by care providers in this study.

Research suggests that surveys of care providers’ can provide important policy-relevant data and information that is often not captured by administrative data or registration databases (Aitken et al. 2008; Barklay et al. 2002; Grava-Gubins & Scott 2008; Scott et al. 2011). Indeed, this study has identified a number of unique findings specific to care providers’ willingness to adopt SEHRs.

When promoting SEHRs to improve care providers’ willingness to adopt, findings of this study suggest that policy makers should focus on the factors of perceived compatibility of SEHRs with care providers’ values relating to patient care, perceived benefits of technology, and perceived potential to improve communication between care providers’. These three factors were identified as having the greatest overall potential to positively influence care providers’ willingness to adopt SEHRs.

In addition to these three key factors which policy makers should focus on, the findings of this study suggest that GP and Specialist staff have the lowest current willingness to adopt SEHRs. Policy makers could use these findings to develop targeted messages towards care providers' operating in these roles to improve their willingness to adopt. Finally, the findings of this study suggest that care providers' operating in the private sector are currently less willing to adopt SEHRs compared to those care providers' operating in the public sector. As with the potential need to develop messages targeted towards care providers' operating within varying roles, targeted messages may be required specifically for the private sector which focus on the three key factors identified by care providers' in this study as providing the greatest influence upon willingness to adopt SEHRs.

This study provides a good starting point for future research on the impact of SEHR technology. This could include longitudinal studies, examining the effects and benefits of implementation of a SEHR system within a specific hospital, or in a more holistic approach, across a state or nation. Furthermore, future research could be conducted to compare the results of the current study later in the diffusion process, for example, after implementation has been mandated, to revisit the perceived costs and benefits of SEHRs to care providers. A number of sections of the questionnaire have been designed to allow gap analysis in relation to perceived potential and actual benefits of technology in health care to be conducted in future research study. Given the limitations identified in Chapter Six and below in Section 7.3.1, it would be recommended that an adapted version of the survey be administered prior to the implementation of the PCEHR System to assist in policy and procedure development for the implementation of PCEHRs and to encourage care providers' willingness to adopt.

7.3.1 Limitations

A limitation of this study is the date in which the questionnaire was conducted (2005). Given the recent push by the Federal Government to implement SEHR technology through their Personally Controlled Electronic Health Record (PCEHR) scheme by July 2012, views of care providers' could potentially have changed due to the upcoming implementation. Indeed, future research to compare care providers' perspectives of SEHRs given the national implementation of the PCEHR system could prove valuable to compare any changes.

In addition to the development and implementation of national programs such as the PCEHR system, a cultural change is occurring within the Australian public sector. Recently, the Commonwealth government recognised that, to be more relevant to its stakeholders, it needs to foster a culture of openness. To that end, a 'Declaration of Open Government' has been developed (Department of Finance and Deregulation 2010). Community expectations about improved access to government records and information have implications for how government manages public sector information. The move towards open government recognises that the value of public sector information as a national strategic resource can be enhanced when it is openly accessible and easily reusable.

Specifically within Queensland, reforms include the change from 'Freedom of Information' to 'Right to Information', moving to a push model for data publication. These changes have resulted in the introduction of the *Right to Information Act 2009* and *Information Privacy Act 2009*, replacing the previous *Freedom of Information Act 1992.* These changes in philosophy towards information resources and an open government may result in changes to responses to this study, and perhaps reinforce the importance of the need for effective information and records management practices. Supporting and maintaining the link between good information and records management practices and ongoing open access to government information is critical, and something which SEHRs have great potential in facilitating.

The data collection instrument utilised for this study could also be considered a limitation. All information including future willingness to adopt SEHRs were self reported by respondents. While self administered questionnaires are considered a generally accepted measure of administration (Zikmund 2003), future replications of the study could use other objective measures to obtain more valid and reliable results. Such methods could include interviews and observations.

The administration method of this questionnaire could also be considered a limitation. While distribution of the survey by mail can be considered a typical way to distribute surveys (Zikmund 2003), there are a number of limitations. For example, respondents could not be identified. Because respondents were not able to be identified, this made it impossible to test for non-response bias, which could have affected results. The distribution of the survey by mail also does not ensure that the intended recipient completed the survey. For example, if the recipient was different to the intended person, their views may be different and therefore results could be inaccurate.

A number of techniques were utilised in this study with the aim of reducing the potential for non-response bias and to ensure the most appropriate person completed the survey. For example, a cover letter outlining potential benefits and relevance to the care provider was developed and attached to the survey so as to influence the care provider to complete the survey. The large sample size, covering all active members of the AMAQ, was also used in an attempt to ensure responses representing the views of the care provider community were attained.

A final potential limitation of this study is the survey of only Queensland care providers' on a topic that is not limited in scope to Queensland only, but contains implications for care providers' across Australia (given the planned introduction of the PCEHR System from July 2012). Given that the role of care providers' is consistent across Australia, it is not envisaged that the focus on Queensland based care providers' would create the potential for high levels of bias.

As a result of the limitations identified above, findings from the data analysis were potentially impacted. Given that the survey was administered in 2005, at which time very few members of the AMAQ had been involved with SEHR's (potentially limiting knowledge of SEHRs) findings from the data analysis did not corresponding to findings from the literature review. In addition, as outlined in Chapter Six, the use of CATPCA and multiple regression analysis for hypothesis testing was not able to fully assess the impact of Relative advantage, Compatibility and Complexity on care providers' willingness to adopt SEHRs.

7.4 Conclusion

Driven by the needs to facilitate clinical and administrative processes, to reduce medical errors, and to reduce healthcare costs, many healthcare institutions both nationally and internationally have been deciding to implement SEHR systems to allow clinical information gathering and access at the point of patient care (Carayon et al. 2009). Shared electronic health record systems can be used to support any number of clinical processes (e.g. accessing progress notes or procedures data, support CPOE (computerised provider order entry) and CDSS (clinical decision support systems)). In addition, SEHRs provide support to a number of administrative procedures such as billing and scheduling. Overall, the use of SEHRs can facilitate clinical decision-making and minimise the potential for mistakes due to the inaccuracy and incompleteness of paper records (Institute of Medicine 2001, Thompson and Brailer 2004, Kawamoto et al. 2005, Ohsfeldt et al. 2005).

This dissertation has analysed future willingness to adopt SEHRs from the perspective of the care provider. The literature suggests that there are three primary factors which influence willingness to adopt any innovation. These factors can be summarised as Relative advantage; Compatibility and Complexity. If these factors are adequately addressed, the literature suggests that willingness to adopt can be greatly enhanced.

The study has sought to make both an applied and a theoretical contribution to the literature. The applied contribution is in the form of establishing a relationship between the factors of Relative advantage, Compatibility and Complexity and care providers' future willingness to adopt SEHRs. The theoretical contribution is achieved by identifying the specific variables which comprise each of the factors which influence care providers' future willingness to adopt SEHRs.

A total of 588 active members of the AMAQ participated in the study, with respondents across both the public and private sector of the health system, as well as a cross section of respondents from across the various tiers of the health system in Queensland.

To test for care providers' future willingness to adopt SEHRs, CATPCA, regression analysis and Chi-Square analysis was used to determine any statistically significant relationships between Relative advantage, Compatibility and Complexity and care providers' future willingness to adopt SEHRs. In addition, any statistically significant difference in future willingness to adopt SEHRs across the tiers of the health system and between the public and private sector were identified.

Results of the analysis of the data found that the factor Relative advantage consisted of two primary dimensions – perceived benefits of technology and the perceived advantages of SEHRs. The variables comprising Relative advantage had a statistically significant potential to influence care providers future willingness to adopt SEHRs at the $\alpha = 0.05$ level.

The factor Compatibility also was found to consist of two primary dimensions, (a) perceived potential to improve communication between care providers and (b) perceived compatibility of SEHRs with care providers' values relating to patient care. Results found that the variables comprising Compatibility had a statistically significant potential to influence care providers' future willingness to adopt SEHRs at the $\alpha = 0.05$ level.

The final factor tested, Complexity, was also described by two primary dimensions, (a) perceptions of complexity relating to information and records management and (b) perceptions of complexity relating to compliance. The variables comprising Complexity were also found to have a statistically significant potential to influence care providers' future willingness to adopt SEHRs at the $\alpha = 0.05$.

Results of the data analysis also proved that there is a statistically significant variation willingness to adopt SEHRs across the tiers of the health system, with hospital staff indicating that they were more willing adopt SEHRs in the future. In addition, there was a statistically significant variation in willingness to adopt between the public and private sector, with a greater proportion of public sector respondents indicating their future willingness to adopt.

Despite the limitations encountered above, this dissertation has identified a number of factors that influence care providers' future willingness to adopt SEHRs. These findings have potential implications for future adoption of SEHR systems, specifically by allowing implementers and policy makers to target the factors that influence willingness to adopt the most.

In order to overcome the limitations identified, a study utilising a larger sample across Australia following the implementation of the national PCEHR system should be conducted in order to strengthen the relationships identified in this dissertation which exist between the factors influencing care providers' future willingness to adopt SEHRs. The re-issuing or building upon the foundations laid by this study would assist in policy and procedure development for the introduction of a national SEHR system in Australia, scheduled for July 2012.

As SEHR technology continues to evolve, and nationally administered programs such as the PCEHR system becomes operational, care providers will continue to see advances in patient care, and other benefits such as cost reductions to their practice. As more patients become accustomed to their care provider's using SEHR technology, the patient's satisfaction will also continue to grow, with the overall aim to improve health care outcomes for all involved in the health system.

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APPENDIX A

QUESTIONNAIRE USED FOR THE STUDY

Shared Electronic Health Records

AN ADOPTION PERSPECTIVE

A DEMOGRAPHICS

A1 My principal role as a care provider would be best described as: *(please tick one box)*

GP ☐1
Specialist ☐3
Resident and Registrar ☐3
Salaried Specialist ☐4
Senior Medical Officer ☐5
Other (*please specify*) ☐6

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A2 In which Region of QLD do you operate?
(please tick the relevant box/es)

Brisbane City ☐1
Brisbane North ☐2
Brisbane South ☐3
Gold Coast ☐4
Ipswich Region ☐5
Toowoomba Region ☐6
Mt Isa ☐7
Sunshine Coast ☐8
North Coast Region ☐9
Rockhampton Region ☐10
Mackay Region ☐11
Townsville Region ☐12
Cairns Region ☐12
Other States ☐14

A3 As a care provider, do you serve in the public or private sector?

Public ☐1
Private ☐2

A4 If you work in a hospital, what is its size?

Small (< 200 beds) ☐1
Large (>200 beds) ☐2
Not Applicable (*skip to question A6)* ☐3

A5 What is the age of the hospital you work in?

Less than 10 years ☐1
Between 10 and 29 years ☐2
30 years and over ☐3

A6 How would you best describe your work organization?

Hospital/medical centre ☐1
Group practice ☐2
Ambulatory care clinic ☐3
Managed care office ☐4
Long term care/rehabilitation centre ☐5
College/university ☐6
Consulting firm ☐7
Pharmaceutical company ☐8
Self employed professional ☐9
Other work setting *(please specify)* ☐10

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A7 Which of the following technologies do you use?
(please tick the appropriate box/es)

Administrative ☐1
Prescription use ☐2
Database searching ☐3
Decision support ☐4
Statistic collection ☐5
Colleague interaction ☐6
Other (*please specify*) ☐7

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A8 Within your daily role, what are the two technologies which you would use the most?
(please number '1' and '2' in the appropriate boxes)

Administrative ☐1
Prescription use ☐2
Database searching ☐3
Decision support ☐4
Statistic collection ☐5
Colleague interaction ☐6
Other (*please specify*) ☐7

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B TECHNOLOGY

B1 Please rate the change in level of technology usage in your organization over the last five years

Large Increase ☐1
Increase ☐2
Steady ☐3
Decrease ☐4
No technology usage ☐5

B2 Do you perceive ‘ease of use’ as a factor which would influence your acceptance of technology?

Yes ☐1
No ☐2

B3 Have you had any input into the level of technology used in your organisation?

Yes ☐1
No ☐2

B4 How do you personally perceive the utilization of technology for your work?

Complex and cumbersome ☐1
Useful in performing daily duties ☐2
Assists in selected duties ☐3
Other (*please specify*) ☐4

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B5 Do you consider that the use of technology provides any professional autonomy?

Yes ☐1
No ☐2

B6 Do you consider that the use of technology could threaten your work autonomy?

Yes ☐1
No ☐2

B7 Do you consider that the use of technology could potentially lead to managerial control over your clinical work?

Yes ☐1
No ☐2

B8 Do you consider that the use of technology helps in providing *continuity* of care?

Yes ☐1
No ☐2

B9 Do you consider that the use of technology, from your perspective, *improves quality* of care?

Yes ☐1
No ☐2

B10 Do you consider that the use of technology improves *your performance* as a care provider?

Yes ☐1
No ☐2

B11 Do you consider that an increased use of technology provides any competitive advantage for an organization compared to other organizations who utilize a lesser degree of technology?

Yes ☐1
No ☐2

B12 Within your daily practice, which of the following processes employ technology? *(please tick the appropriate box/es)*

Treatment ☐1
Decision support ☐2
Data entry ☐3
Reference ☐4
Clinical visits ☐5
Prescription entry ☐6
Advanced use ☐7
(eg. telehealth, wireless PDA’s etc)
Other (*please specify*) ☐8

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B13 Does the technology used in your practice have the potential to facilitate the collection of statistics?

e.g. Patient data, procedure data, overall hospital statistics, self evaluation etc

Yes ☐1
No ☐2

B14 Does the technology used in your practice *actually* facilitate the collection of statistics?
e.g. Patient data, procedure data, overall hospital statistics, self evaluation etc

Yes ☐1
No ☐2

B15 Please rate the *potential* and *actual* benefits of technology in relation to the information needs listed below
(*The rating scale is as follows: 1 = Great benefit; 2 = Moderate benefit; 3 = Some benefit; 4 = Little benefit; 5 = No benefit; 6 = Not Applicable)*

(a) Greater accessibility to individual patient medical history
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(b) Improved accuracy of patient identification
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(c) Greater accessibility to treatment and support information available to the patient
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(d) Reduced time spent on routine administrative tasks
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(e) Increased time effectiveness of patient visits
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(f) Elimination of errors such as wrong treatment venue
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(g) Elimination of errors such as wrong surgery/procedure
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(h) Facilitation of rapid delivery of test results
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(i) Improved *provider* satisfaction with patient care
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(j) Improved *patient* satisfaction with treatment
Potential benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Actual benefit
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

B16 Please rate your agreement or disagreement with the following statements:

(1) The use of technology has the ***potential*** to facilitate communication amongst the following groups:
(*The rating scale is as follows: 1 = Strongly agree; 2 = Agree; 3 = Neutral; 4 = Disagree; 5 = Strongly disagree; 6 = Not Applicable)*

(a) Clinicians
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
(b) Caregivers
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
(c) Organizational personnel
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
(d) Specialists
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
(e) Pharmacists
☐1 ☐2 ☐3 ☐4 ☐5 ☐6
(f) Other *(please specify below)*
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(2) The use of technology ***actually*** facilitates communication amongst the following groups:

(*Your rating scale will be as follows: 1 = Strongly agree; 2 = Agree; 3 = Neutral; 4 = Disagree; 5 = Strongly disagree; 6 = Not Applicable)*

(a) Clinicians
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(b) Caregivers
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(c) Organizational personnel
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(d) Specialists
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(e) Pharmacists
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(f) Other *(please specify below)*

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C PATIENT CARE

C1 Please rate your agreement or disagreement with the following statements relating to the use of technology in patient care:

(*The rating scale is as follows: 1 = Strongly agree; 2 = Agree; 3 = Neutral; 4 = Disagree; 5 = Strongly disagree)*

(a) The use of technology in patient care has increased the cost of treatment
☐1 ☐2 ☐3 ☐4 ☐5

(b) The use of technology in patient care generally improves the outcome of treatments
☐1 ☐2 ☐3 ☐4 ☐5

(c) The use of technology in patient care has led to more patients choosing that practice for treatment?
☐1 ☐2 ☐3 ☐4 ☐5

(d) The use of technology in patient care generally reduces error in prescribed medications
☐1 ☐2 ☐3 ☐4 ☐5

(e) The use of technology in patient care provides access to less timely healthcare for patients
☐1 ☐2 ☐3 ☐4 ☐5

D COMPLIANCE

D1 Does your organization follow any *voluntary Standards and codes of practice* relating to the management of patient information?
Eg. AS4400 (1995); RACGP Code of Practice for the Management of Health information in General Practice etc.

Yes ☐1
No ☐2
Unsure ☐3

If yes, outline which one/s?

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D2 I have an understanding of commonwealth and state legislation impacting upon my organization

Yes ☐1 *(if yes, then go to question D3)*
No ☐2 *(if no, then go to question D5)*

D3 Which *commonwealth statutes* for information management does your organization adhere to?

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D4 Which *state laws* relating to information management does your practice adhere to?

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D5 Please rate your agreement or disagreement with the following statements regarding the impact of legislation on your role as a health care provider:

(*The rating scale is as follows: 1 = Strongly agree; 2 = Agree; 3 = Neutral; 4 = Disagree; 5 = Strongly disagree; 6 = Not Applicable)*

(a) You or your organization has/have become more aware of legislative requirements relating to the management of patient health records in the past five years?
☐1 ☐2 ☐3 ☐4 ☐5 ☐6

(b) Increased *privacy legislation* has impacted upon my practice in the past five years?

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

If so, how has it impacted?

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(c) An increase in *litigation* has impacted upon my management of patient records in the past five years?

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

If so, how has it impacted?

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D6 Please rate how well your organization meets the following aspects of creating and keeping information required by the various Commonwealth and State bodies:

(*The rating scale is as follows: 1 = Excellent; 2 = Very well; 3 = Adequate; 4 = Poorly; 5 = Very poorly)*

(a) Gathering and keeping all appropriate information and records

☐1 ☐2 ☐3 ☐4 ☐5

(b) Appropriate storage of information

☐1 ☐2 ☐3 ☐4 ☐5

(c) Reliability of information

☐1 ☐2 ☐3 ☐4 ☐5

(d) Protection of information against unauthorized use and alteration

☐1 ☐2 ☐3 ☐4 ☐5

D7 Rate the impact of increasing media coverage relating to medical errors upon the way in which your organization makes and keeps records?

Strong Impact	☐1
Slight Impact	☐2
Steady	☐3
Little Impact	☐4
No Impact	☐5

D8 If there has been an impact as described in D7, how has it affected your organization?

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E **SHARED ELECTRONIC HEALTH RECORDS (SEHRs)**

SEHRs refer to an electronic collection of personal health information relating to the past, present or future physical/mental health, or condition of an individual, entered or accepted by health care providers, which can be securely stored and distributed.

E1 Are you aware of trials of shared electronic health records (SEHRS) in systems such as HealthConnect?

Yes	☐1
No	☐2 *(if no, then go to question E3)*

E2 Have the results of these trials had any influence on your willingness to adopt SEHRs?

Yes	☐1
No	☐2

E3 Is your organization contemplating future use, been previously involved in, or currently involved in any trials of a system of shared electronic health records such as HealthConnect?

Future	Yes	☐1	No	☐2
Previous	Yes	☐1	No	☐2
Current	Yes	☐1	No	☐2

E4 What important changes in the work process occurred after, or do you perceive as occurring after, the introduction of SEHRs?

Future

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Previous

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Current

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E5 How would you rate your *willingness* to adopt the SEHR system you are currently involved in, or to adopt a SEHR system at some time in the future?

	Current	**Future**
Extremely willing	☐1	☐1
Very willing	☐2	☐2
Somewhat willing	☐3	☐3
Some concerns	☐4	☐4
Extremely against	☐5	☐5

E6 What factors have, or would be likely to *positively affect* your willingness to implement a SEHR system?
(please tick the appropriate box/es)

	Current	**Future**
Decreased Workloads	☐1	☐1
Improved Care provider privacy	☐2	☐2
Improved Patient Privacy	☐3	☐3
Decreased Administrative Costs	☐4	☐4
Increased Patient Satisfaction	☐5	☐5
Improved Patient Care	☐6	☐6
Reduced System Complexity	☐7	☐7
Increased Legislative Compliance	☐8	☐8
Other	☐9	☐9

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E7 What factors have, or would be likely to *negatively affect* your willingness to implement a SEHR system?
(please tick the appropriate box/es)

	Current	**Future**
Increased Workloads	☐1	☐1
Decreased Care provider privacy	☐2	☐2
Decreased Patient Privacy	☐3	☐3
Increased Administrative Costs	☐4	☐4
Decreased Patient Satisfaction	☐5	☐5
Decreased Patient Care	☐6	☐6
Increased System Complexity	☐7	☐7
Decreased Legislative Compliance	☐8	☐8
Other	☐9	☐9

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E8 Do you believe that SEHRs will improve communication with other care providers?

Yes ☐1
No ☐2

E8ii Would this impact on your willingness to implement a SEHR system?

Yes ☐1
No ☐2

E9 Do you believe that SEHRs will help facilitate legal defence in the event of litigation relating to patient care?

Yes ☐1
No ☐2

E9ii Would this impact on your willingness to implement a SEHR system?

Yes ☐1
No ☐2

E10 Do you believe that SEHRs will add to your administrative work commitments?

Yes ☐1
No ☐2

E10ii Would this impact on your willingness to implement a SEHR system?

Yes ☐1
No ☐2

E11 Do you believe that SEHRs will be compatible with existing values relating to the confidentiality between the care provider and their patient's?

Yes ☐1
No ☐2

E11ii Would this impact on your willingness to implement a SEHR system?

Yes ☐1
No ☐2

E12 Do you believe that SEHRs will create any difficulties in meeting with legislative requirements?
eg. The Privacy Act; Freedom of Information Act, etc

Yes ☐1
No ☐2
If so, how

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E12ii Would this impact on your willingness to implement a SEHR system?

Yes ☐1
No ☐2

E13 Do you feel that SEHRs will:
(please tick one box only)

Increase time available to interact with patients ☐1
Limit time available to interact with patients ☐2

E13ii Would this impact on your willingness to implement a SEHR system?

Yes ☐1
No ☐2

E14 Do you feel that the use of SEHRs will create a competitive advantage for your organization?

Yes ☐1 *(if yes, then go to question E15)*
No ☐2 *(if no, then go to question E16)*

E14ii Would this impact on your willingness to implement a SEHR system?

Yes ☐1
No ☐2

E15 In which areas do you believe that your organization would gain a competitive advantage?

Collaboration with other care providers ☐1
Collaboration with related organization ☐2
Quality of patient care ☐3
Timeliness of patient care ☐4
Personal workloads ☐5
Other ☐6

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E16 Please rate the attributes you perceive as most important for a SEHR system

Ease of use ☐1
Usefulness to care providers ☐2
Public Image – acceptance of SEHR ☐3
Relative advantage over existing systems ☐4
Compatibility with existing systems/values ☐5
Individual Patient Trust ☐6
Ease of Collaboration ☐7
Other ☐8

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E17 What, in your opinion, is the main potential *benefit* of the SEHR, compared to current systems for patient records?

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E18 What, in your opinion, is the main potential *problem* of the SEHR, compared to current systems for patient records?

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APPENDIX B

COVERING LETTER ATTACHED TO SURVEY

USQ
AUSTRALIA

FACULTY OF BUSINESS
Troy Pullen, B.Bus (1st class Honours) PhD Student
PHONE: (07) 4631 5463
FAX: (07) 4631 5594
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Dear Sir/Madam

The use of technology is essential in providing the most accurate, up to date information to any care provider in the health sector, in any situation, whether as a result of a routine check-up at the General Practitioner's office, or a complicated medical procedure in the operating room.

Systems that manage information (information management/recordkeeping systems) in any industry are increasingly regarded as critically important. Effective systems can provide access to the right information at the right time to aid in the decision making process for clinicians and also for patients in order to reduce tragic loss of life.

A shared electronic health record (SEHR) system is identified as a way in which improved patient care can be achieved. Recently, much work has been undertaken to develop EHRs to meet specific needs and requirements of various stakeholders. Countries currently developing electronic health systems and Standards for these systems include the UK, Netherlands, USA, Australia and Canada. In Australia, this system is known as HealthConnect.

HealthConnect is Australia's first health information network. It aims to improve the flow of information across the Australian health sector. A national approach is designed to create greater coherence, establish national standards and provide a framework for compatible systems across the nation. The idea of EHRs began at least 40 years ago, but the first implementations did not begin until the 1980s.The widespread clinical use of EHRs has previously never progressed past the concept stage.

The following questionnaire will identify those factors which have the greatest impact upon the decision to accept a change from traditional methods of managing patient records to the concept of the shared environment.

Your organisation is one of a number in which people are being asked to provide perceptions of how technology (including SEHRs) and legislation may impact upon patient care. In order for the results to reflect the care provider community, it is important that the questionnaire be completed and returned. The questionnaire is not extensive, and should require no more than twenty minutes to complete. To return the completed questionnaire, please use the reply paid envelope provided within.

You may be assured of complete confidentiality. Neither your name nor the name of your organisation is required on the questionnaire.

This research is being conducted as part of my PhD studies, analysing care providers' willingness to adopt SEHRs. Upon completion of the research, factors identified as most influential on the decision to adopt can be targeted, and addressed in the process of implementing change in the vital area of SEHRs.

You may receive a summary of results by contacting me via email at pullen@usq.edu.au and request a copy. I would be most happy to answer any questions you may have. Please email or call using the contact details supplied above. If you wish to verify any matter relating to this research, my supervisor Dr Heather Maguire will be happy to answer your queries. She can be contacted by telephone at (07) 4631 1273, or by email at maguireh@usq.edu.au.

Thank you for your assistance.
Yours Sincerely

Troy Pullen