The impact of the introduction of a pilot electronic health record system on general practitioners' work practices in the Illawarra

Karolyn Annette Spinks
University of Wollongong

The Impact of the Introduction of a Pilot Electronic Health Record System on General Practitioners' Work Practices in the Illawarra

Includes an Observation Study

A thesis submitted in fulfillment for the award of Masters
of Information and Communication Technology (Research)

Karolyn Annette Spinks

RN, Assoc Dip Comp Apl, B Comm BSA

School of Information Technology and Computer Science
University of Wollongong

2006

Certification

I, Karolyn Annette Spinks declare that this thesis, submitted in fulfillment of the requirements for the award of Master of Information and Communication Technology, in the school of Information Technology and Computer Science, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualification in any other university or academic institution.

Karolyn Spinks

24 April 2006

As reported anonymously in the London *Times*:
"After René Laënnec invented the stethoscope in 1816… That the [stethoscope] will ever come into general use notwithstanding its value is extremely doubtful, because its beneficial application requires much time and gives a good bit of trouble to the patient and to the practitioner, and because its hue and character are foreign and opposed to our habits and associations…"

Slack W. (2001). Cybermedicine, How Computing Empowers Doctors and Patients for Better Health Care, Jossey-Bass, A Wiley Company, San Francisco, California, p 88.

Acknowledgements

I feel much gratitude to a number of people who provided assistance in many forms during the years of undertaking this research.

Firstly, acknowledgement must be given to all the GPs and patients from the Illawarra involved in the Illawarra Divison of General Practice Diabetes Research Program who agreed to participate in the research and who gave me their valuable time. Without you there would be no thesis.

My supervisors Professor Joan Cooper, Flinders University and Dr Ping Yu, University of Wollongong, for their enduring encouragement, guidance and insightful feedback throughout the research undertaking and thesis preparation. I have gained from your experience and wisdom during this project. Thank you so very much.

The invaluable and continuous reassurance, support, patience and guidance given by my husband, Professor Geoffrey Spinks. I am conscious that you lived through this project with me, sharing both the ups and downs. I am indebted to you for your support and also your gracious gift of time. Acknowledgement must also go to my two wonderful children Robert and Richard Spinks for their understanding, patience and encouragement.

The staff and students of the University of Wollongong involved in the Smart ID Information System project.

Staff at the Illawarra Division of General Practice

I would also like to acknowledge the financial support of an Australian Postgraduate Award Industry (APAI) scholarship whilst undertaking this research.

Dedication

This thesis is dedicated to all the people that read it who may take some interesting and worthwhile information away with them in doing so.

Abstract

This thesis assessed the impact of the use of information technology (IT), specifically, electronic health records (EHRs), on general practitioners' (GPs') clinical work practices in NSW, Australia. The research framework and context was taken from EHR initiatives proposed by the Australian Commonwealth and State Governments for improving the Australian Healthcare system. A new system that provided increased access to electronic patient information was trialed in the Illawarra Region of NSW specifically utilizing a Smart ID Information System. The current research was administered under this larger project. The current research examined the Smart ID Information System (a pilot system designed to emulate EHRs) so the impact of EHRs on GPs' work practices could be considered.

GPs work practices are hindered partially because Information and Communication Technology (ICT) infrastructure is not yet available to support them in their need to easily exchange patient information. Consequently patient clinical information is sometimes unavailable because it involves a labour intensive process to obtain that information. In solving the above problems with EHRs other problems are created such as positive identification of patients and their results and records. Also, issues of the threat to patients' privacy and confidentiality are enormous. The research question is therefore: how are GPs' clinical work practices impacted by the introduction of EHRs and associated unique patient identifiers (UPIs)?

The research methodology was both a quantitative and qualitative inquiry which focused on two aspects of the Smart ID Information System project. It was broken into two parts plus supplementary results from a closely related study were used as secondary data. Firstly, a perception study investigated GPs' perceptions of current and future accessibility to patient clinical information and what their needs were, for acceptance of EHRs in general practice. This study was achieved through interviewing GPs. Secondly, an observation study investigated how the adoption of EHRs in the form of a pilot EHR system (Smart ID Information System) impacted on GP clinical work practices through observation of GP work practices. Results from secondary data were included here and discussed in the conclusion.

Results of the perception study showed GPs agreed there was a problem with the exchange of patient information and the information flow between health service providers. The GPs were generally willing to use IT (via EHRs) to improve their work efficiency. They believed EHRs could help provide a solution, which overcame the existing problem of lack of patient information. The GPs were keen to increase the amount of information exchanged. Overall the idea of the Smart ID Information System as a pilot EHR system was well received by the GPs interviewed but the GPs highlighted the pilot EHR system implemented must be simple to use. Results of the observation study showed GPs successfully used the pilot EHR system within their consulting environment. The GPs proved they could successfully access the patient's record, integrate this access procedure and subsequent discussion of the information with the patient, into the consultation whilst maintaining their autonomy for their personal routine and work practices. The GPs found the access and consent procedure facilitated via the I-keys was quick and simple to use despite slow system performance. Both consultations in which the system was used were longer. Results of follow-up interviews from secondary data indicated GPs were willing to accept the technology knowing the benefits they would gain from its use. Of the GPs interviewed one GP thought consultations were longer, a second GP thought the length of consultations stayed the same.

In conclusion the research found GPs agreed their work practices were hindered by inefficiencies due to non-availability of patient clinical information, and any system to improve this efficiency must be simple to use. EHRs (and UPIs) have minimal impact on GPs work practices and GPs studied were reasonably comfortable with the impact EHRs have on their work practices but this is only if EHRs do not significantly lengthen consultation times, such an EHR system runs efficiently, and excellent infrastructure is in place to support GPs. Results relating to consultation length with EHRs were inconclusive due to some consultations staying the same and some becoming longer. However, there is a possibility consultation length will increase with EHRs due to increased availability of patient information and dependency on prevailing technology.

The current research involved a direct GP – patient relationship. Future research of EHRs in general practice could include an extension of the current research to incorporate an indirect GP – patient relationship. This is where significant benefits lie

for GPs and patients from using EHRs. Another suggestion of future research could be the impact of EHRs and UPIs on the work practices of practice management staff, including receptionists and practice nurses working in GP's surgeries.

Table of Contents

List of Figures

List of Plates

List of Tables

List of Acronyms and Abbreviations

AHMAC	Australian Health Ministers Advisory Council
AMA	Australian Medical Association
APA	American Psychiatric Association
CPR	Computerized Patient Record
DHAC	Department of Health and Aged Care
DHHS	Department of Health and Human Services
EHR	Electronic Health Record
GP	General Practitioner
GPB	General Practice Branch (in Dept of Health and Aged Care)
GPCG	General Practice Computing Group
GPFG	General Practice Financing Group
GPPAC	General Practice Partnership Advisory Council
GPSRG	General Practice Strategy Review Group
HIC	Health Insurance Commission
HINA	Health Information Network Australia
ICT	Information and Communication Technology
IDGP	Illawarra Division of General Practice
IS	Information System
NSW MACPHI	NSW Ministerial Advisory Committee on Privacy and Health Information
NEHRT	National Electronic Health Records Taskforce
NHIMAC	National Health Information Management Advisory Council
NHS (UK)	National Health Service, UK
MRN	Medical Record Number
PAS	Patient administration system
PCP	Primary Care Partnerships
PDA	Personal Digital Assistant
PIP	Practice Incentives Program
RACGP	Royal Australian College of General Practitioners
SSL	Secure Socket Layer
WAP	Wireless Application Protocol
UOW	University of Wollongong
UPI	Unique Patient Identifier

Publications Arising From the Research

1. Spinks K., Soar J., Cooper J., (2003). "Changes in GP Workflow Associated With E-consent and Access Control to Remote Patient Clinical Information", In *Proc. Health Informatics Conference (HIC 2003),* Sydney, Australia, Aug 10-12, 2003, Handbook of Abstracts (Eds) Coiera E., Simpson C.,ISBN #:0 9751013 0 7 (Title of Abstract in Handbook: What is the impact on GP workflow processes of Patient Identifiers/UPIs in primary care?)

2. Spinks K, Cooper J, (2001) "Results of a Study of Acceptance of Unique Patient Identifiers in a General Practice Setting", In *Proc.Health Informatics Conference (HIC 2001), Canberra, Australia,* July 29-31, 2001, Handbook of Abstracts (Eds) James P., Smith J., Smith L., ISBN 0 9585370 8 9 (Title of Abstract in Handbook: GP attitudes to and acceptance of a Smart IS using distributed patient information folders and UPIs)

3. Spinks K., Fulcher J., Dalley A., (2001) "Survey of GP Attitudes to smartcards", In *Proc. 10th Health Informatics Association NSW Conf.,* Hunter Valley, NSW, Australia, 17-18 February.

1 Introduction

This thesis assesses the impact of the use of information technology (IT), particularly, electronic health records (EHRs), on general practitioners' clinical work practices in NSW, Australia. By taking an observation study approach of researching the impact of a small-scale system designed to emulate EHRs, the possible impact of EHRs on general practitioners' (GPs') work practices can be considered. The identified impacts, whether they materialize as negative, positive, significant or inconsequential, may indirectly influence changes to EHR systems and/or the way doctors work in private practice. The outcome of the research will guide health information system (IS) development by aligning IS's with work practices of health service providers.

For the purpose of clarity, in this thesis the term EHRs refers to linked EHRs. It adopts the standard definition of EHRs used in Australia as provided in Appendix A, 'List of Definition of Terms'. This definition is as follows:

> "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."
>
> National Electronic Health Record Taskforce, 2000 pXV

This chapter introduces the various facets of the research to establish the milieu for the remainder of the thesis. It begins with a description of the research topic, and of the larger project within which this current research sits. It is followed by background to and statement of the research problem, an overview of the study itself including components of the study, aims, objectives, scope, limitations, research design, relevance and justification. Also provided is an overview of the structure of the thesis. Lastly, a list of assumptions is given.

1.1 Research Topic

There has been much discussion on the idea of an Australian EHR system, Health Information Network Australia (HINA), and how beneficial such a system would be for Australia's healthcare system. In recent years, proposals for such a system have been initiated by both State and Commonwealth Governments with the aim of improving Australia's healthcare system. In 1999, the then Commonwealth, State and Territory Health Ministers agreed that a new EHR-based national health information network would offer significant improvements to the existing health system in Australia and that benefits would prevail over drawbacks, risks, and challenges to its implementation. To date, however, the impact of IT in the form of EHRs in the general practice arena of the Australian healthcare system has been an under researched area.

This thesis identifies the impact of the IT use, in this case, EHRs, on GPs' clinical work practices. The current research was part of a larger project collaboratively conducted by the University of Wollongong (UOW) and the Illawarra Division of General Practice (IDGP). The title of the larger project was "Design and implementation of a GP-centric Smart ID Information System with distributed patient information folders (PIFs) and unique patient identifiers". After several changes in the design of the Smart ID Information System, the resulting system employed a centralized database rather than a distributed database. This larger project was sponsored by a SPIRT grant from the Australian Research Council.

The current research focused specifically on two aspects of the Smart ID Information System project. Firstly, it investigated GPs' perceptions of current and future accessibility to patient clinical information and what their needs were for acceptance of EHRs in general practice. Secondly, it investigated how the adoption of EHRs in the form of a pilot EHR system (Smart ID Information System) impacted on GP clinical work practices.

The research framework and context is set by the above mentioned EHR initiatives proposed by the Australian Commonwealth and State Governments for the Australian Healthcare system.

To understand the current research topic, it is necessary to understand the larger project that the current research is derived from.

1.1.1 Smart ID Information System Project

The Smart ID Information System provided an electronic method for the transfer and access of data between selected doctors' surgeries, selected diabetic patients and the IDGP. The aim of the system was to increase access to patient clinical information for general practitioners and patients at the point of care, specifically when patients visit GPs who were not their regular GP. An additional aim of the system was to increase access for the selected patients to their own clinical information at a point of access outside the surgery such as their home or other preferred access place of their choice.

The Smart ID Information System encompassed the use of EHRs, UPIs, the Internet, and a personal USB I-Key device in a closed, controlled general practice environment. Presentation and use of the personal I-key held by each patient and each GP facilitated provision of consent to access the patient's personal health details. UPIs facilitated linkage to the patient's personal EHR containing diabetes information. The UPI was stored within the I-key. Originally a smart card was considered instead of a USB I-Key as the personal access device. Also considered was a portable electronic device such as a WAP enabled mobile phone or personal digital assistant (PDA) to enable GPs to remotely access patient records whilst outside the surgery. It was decided by the project chief investigators to limit the scope of the project such that these devices were not deemed necessary.

There have been several research projects realized from the large Smart ID Information System project. Summaries of findings of the larger project have been published (Bomba et al, 2004; Fulcher, 2004; Dalley et al, 2005). As a result of the large project an

access model for EHRs with smart tokens (I-keys) was developed (Dalley et al, in press).

Figure 1.1 is a graphical representation and summary of the Smart ID Information System.

The Smart ID Information System was applied in a private practice setting in primary care. The project stakeholders viewed the Smart ID Information System as a scaled down version of the NSW Government EHR project and Health*Connect*, the Commonwealth coordinated e-health initiative for Australia involving bipartisan commitment from national, state and territory governments. This similarity exists as the Smart ID Information System project involved transfer and access of clinical patient data beyond the surgery boundaries and utilized similar concepts as the latter two projects, namely EHRs, UPIs, and the Internet.

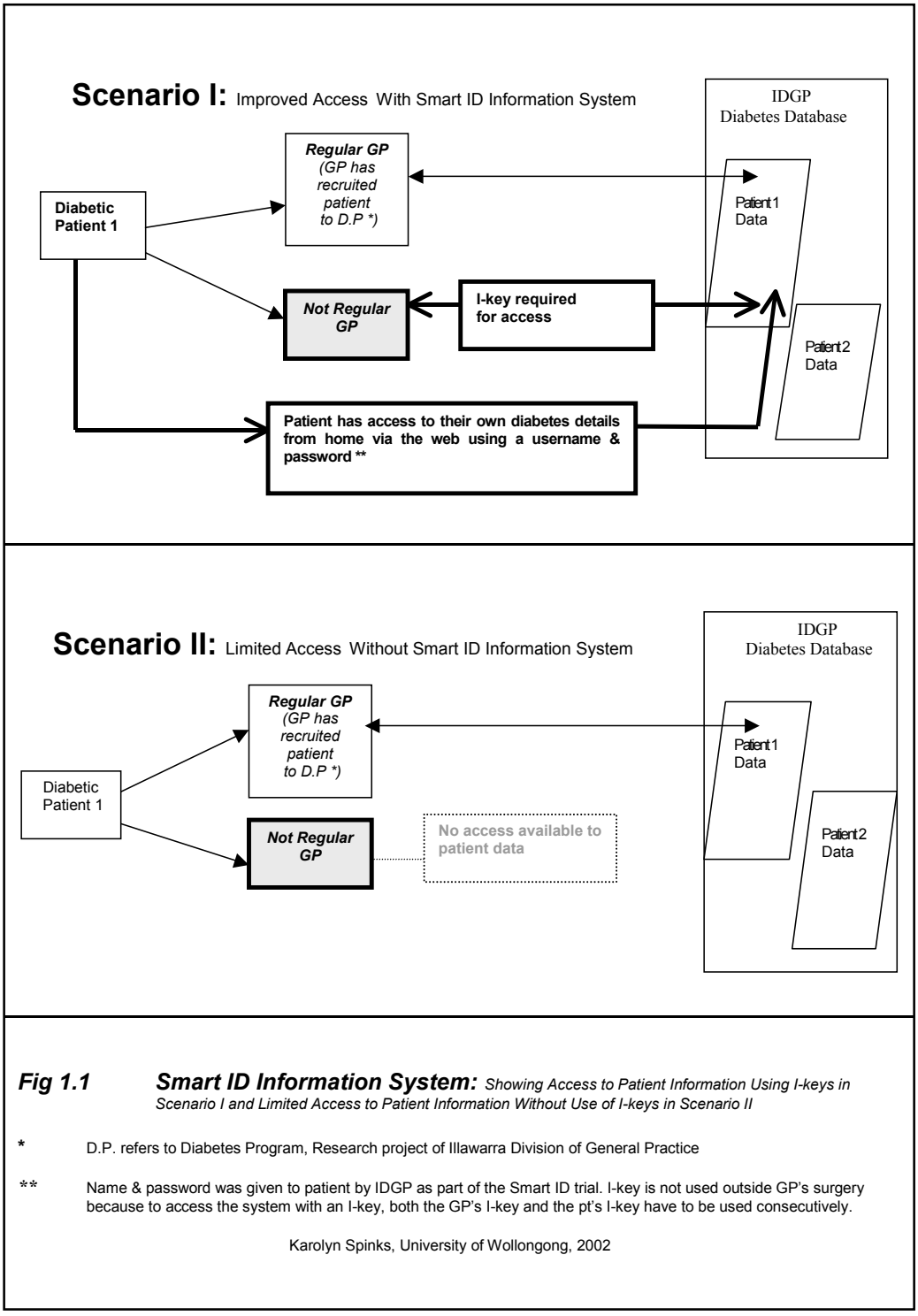


Fig 1.1 ***Smart ID Information System:*** *Showing Access to Patient Information Using I-keys in Scenario I and Limited Access to Patient Information Without Use of I-keys in Scenario II*

* D.P. refers to Diabetes Program, Research project of Illawarra Division of General Practice

** Name & password was given to patient by IDGP as part of the Smart ID trial. I-key is not used outside GP's surgery because to access the system with an I-key, both the GP's I-key and the pt's I-key have to be used consecutively.

Karolyn Spinks, University of Wollongong, 2002

1.2 Background to the Research Problem

In November 1999, the Australian Commonwealth government formed the National Electronic Health Records Taskforce, to report on a national approach to electronic health records with the aim of improving the flow of information across the Australian Healthcare system. Their report, "A Health Information Network for Australia", was released and endorsed by health ministers in July 2000 (NEHRT, 2000, pXIII - 192). This initiative was to become known as Health*Connect* and Medi*Connect*. Likewise, at a state level, in March 2000, the NSW Health Council submitted a report "A better health system for NSW". This report suggested recommendations for a NSW EHR system (NSW Health Council 2000, p XI -104). This initiative evolved to become known as NSW EHR*Net.

Health*Connect* is the initiative most relevant to the current research as it directly involves general practitioners. In summary, Health*Connect* involves collection, storage and exchange of consumer health records via a secure computer network. It also utilizes strict privacy policies, procedures and legislation to protect consumer health information. Health*Connect's* aim is to provide more integrated care and improved outcomes across the health care system due to the improved flow of health information. Initially trial sites were used to test the Health*Connect* concept. In March 2004 it was announced that Health*Connect* would be implemented Australia wide (Health*Connect* Program Office 2005). More information on Health*Connect* is provided in Appendix B of this thesis.

So it is widely recognized that there is a need to improve the exchange of patient health information within the Australian Healthcare system. Enlightened by these IT reforms in the Australian Healthcare system, the large Smart ID Information System project aimed to investigate a solution for better access to quality healthcare information for general practitioners. The current research, which aims to examine the impact of such information access on GPs work practices, also used these Australian healthcare system IT reforms for its own background framework. Further discussion of the impact of information access on GPs work practices is provided in the next section.

1.3 Statement of the Research Problem and Research Question

It is commonly known, (NEHRT 2000 p 171 – 177, NSW Health Council 2000 p22-23), inadequate available health information may result not only in adverse events for patients such as health complications but lack of information is disruptive to the efficient work routine of health service providers including GPs.

More specifically, the inadequacies of current Information Systems (IS) in general practice, do not facilitate transfer of clinical patient information beyond the surgery boundary to support current and future GP clinical work practices and optimal decision-making (NSW Health Council 2000, p 9,18,22).

With proposed changes for making patient clinical information more electronically accessible to GPs, such as the receipt of electronic pathology results, and the future introduction of EHRs (NHIMAC 1999, NEHRT 2000, NSW MACPHI 2000), it is likely GPs' clinical work practices will be impacted. The exact nature of the impact, the extent of the impact are issues that to date have received little research attention.

Issues that need to be considered when examining the impact of EHRs on GPs' clinical work practices include: positive identification of the patient's records with the patient at the time of consultation (Appavu 1997, 1999), method of access and management of access to the patient's EHR (Bomba et al 2004, Dalley et al 2005, Dalley et al in press), patient consent, the doctor-patient relationship including issues of privacy, confidentiality and trust (APA 1999, Stein 1997, NSW MACPHI 2000), the manual input required by GPs when electronically exchanging patient information, interaction with the user interface, quality of patient care, length of consultation (Health*Connect* Program Office, 2003, vol 3, part 3, p18), degree of computer technology integration and flexibility with other tasks such as clinical examination.

At present, GPs' clinical work practices are hindered partially because IT and telecommunication strategies and infrastructure such as health information standards are still being developed to su-pport them in their need to easily exchange patient

information electronically (Heard et al 2000, p14, NSW Health Council 2000 p27). Consequently patient clinical information is sometimes unavailable because it involves a labour intensive process to obtain that paper-based information.

The introduction of EHRs may solve the problem of inadequate information access in general practice. However, in doing so secondary problems may be created. These problems include positive identification of the patient with the patient's EHR, threat to patients' privacy and confidentiality, impact on general practitioners' clinical work practices and the impact on quality of care provided. Finally, the impact on consumer health outcomes must be considered. Many of these issues, including the impact of EHRs on GP clinical work practices are areas that have received little coverage in research. Therefore, the main research question for the current research is: how are GPs' clinical work practices impacted by the introduction of electronic health records and associated unique patient identifiers?

Figure 1.2 shows graphically a general overview of some of the above-mentioned issues currently faced by GPs.

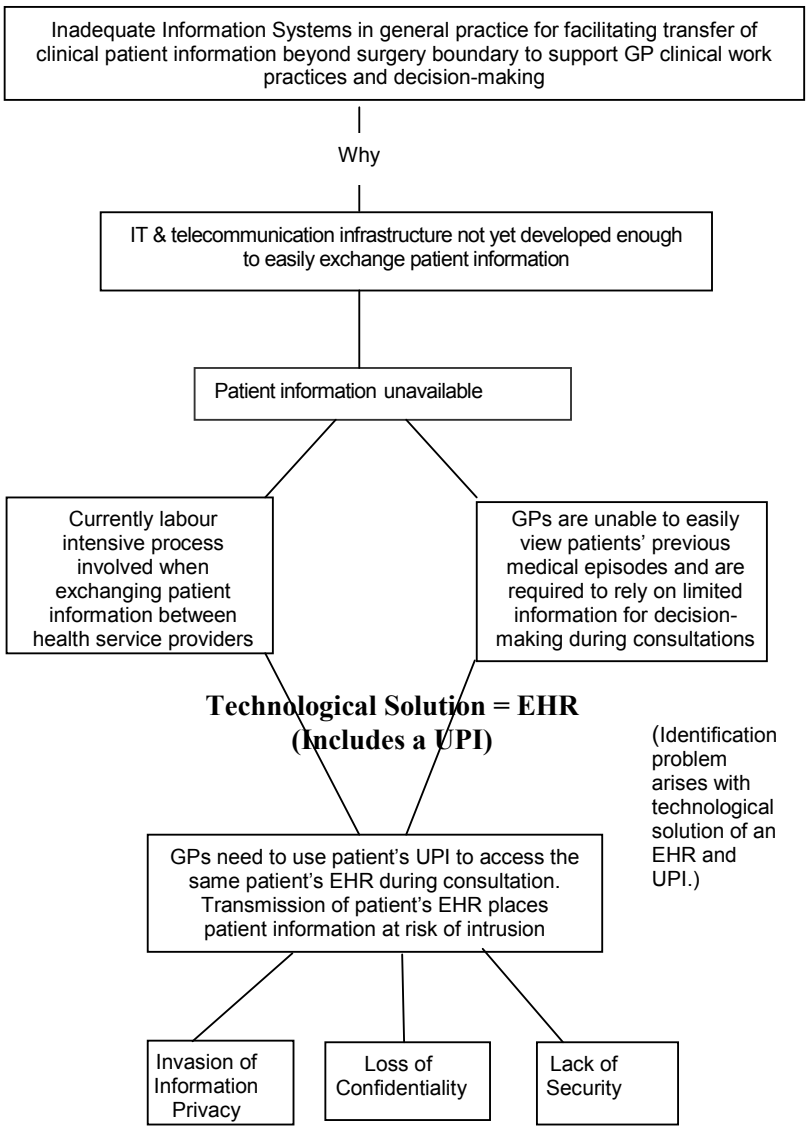


Fig 1.2 Statement of the Problem. Karolyn Spinks, University of Wollongong, 2002

1.4 The Study

1.4.1 Components of the Study

The research question is how are GPs' clinical work practices impacted by the introduction of electronic health records and associated unique patient identifiers? In order to answer this question the research took two approaches. These were:

1. Assessment of GPs' perceptions with accessing and exchanging clinical patient information both manually and electronically. This perception study also assesses GPs' attitudes towards introduction of EHRs via use of a small-scale system designed to emulate EHRs, Smart ID Information System.

2. Observation of GP work practices during GP-patient consultations using a small-scale system designed to simulate EHRs: Smart ID Information System. Assessment of how GPs' work practices are impacted by the use of the system; which parts need be changed and if so in which way.

Secondary data is used to supplement the above two components.

1.4.2 Research Aim and Objectives

The main research aim is to assess the impact of IT, specifically EHRs on GPs' clinical work practices. It does this by assessing GPs' perceptions of accessibility to clinical patient information and observing GPs' use of EHRs during patient consultations through the use of a pilot EHR, the Smart ID Information System.

The specific research objectives are:

1. to determine if GPs perceive a problem with the exchange of patient information between GPs and other health service providers

2. to understand issues/problems facing GPs prior to the implementation of pilot EHRs via a micro project in general practice: Smart ID Information System

3. to ascertain GPs' perceived benefits/risks of using a pilot EHR: Smart ID Information System, using UPIs in conjunction with a portable electronic

device, to access patient records and exchange healthcare information between health service providers

4. to assess general practitioners' daily clinical work practices during consultations highlighting the difference in how a GP works with and without EHRs and UPIs via using the Smart ID Information System with I-keys as the access device

1.4.3 Scope and Limitations

1.4.3.1 Scope of the research

The study focuses on GPs' clinical work practices and some business practices relating to patient identification. The cost of consultations is excluded.

The scope of the research encompasses IT use at the point of care in private practice as opposed to secondary care or tertiary care.

Investigation into impact on consumer health outcomes associated with EHRs and the impact on GP clinical work practices is beyond the scope of this research project.

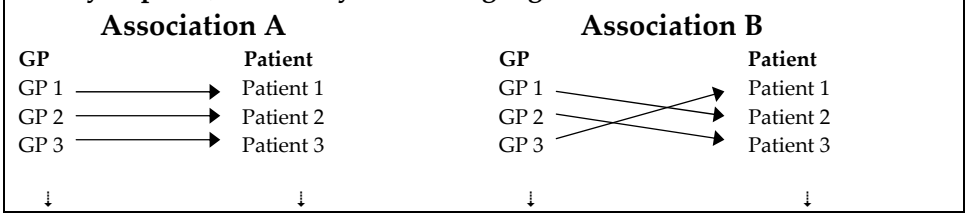
Patient consent is closely related to the topic of EHRs and GP clinical work practices. It is a large subject in itself, and is beyond the scope of the thesis. Nevertheless, it is necessary to discuss patient consent due to its relevance to other topics such as privacy and access to patients' EHRs during consultations in general practice, however, the discussion of consent is limited in the thesis.

Discussion of options or working models for improving lack of interdisciplinary cooperation between hospitals, GPs and other health service providers is beyond the scope of this research.

The research is an observation study that engaged GPs and their regular patients. The scope is explained diagrammatically below in Figure 1.3. The current study utilized the arrangement under association A in Figure 1.3 which shows a direct relationship between GP 1 and Patient 1, GP 2 and Patient 2, GP 3 and Patient 3. Association A was

deliberately chosen for investigation because it enabled assessment of EHRs on GPs' work practices in their most typical consultations.

Fig 1.3 GP –Patient Association
Karolyn Spinks, University of Wollongong, 2004



Association B in Fig 1.3 shows an indirect relationship between GP 1 and Patient 2, GP 2 and Patient 3, GP 3 and Patient 1. This relationship demonstrates the concept of engaging GPs and non-regular patients. However Association B was considered logistically difficult to organise and deemed beyond the scope of the current research. It is worth noting at this point that this association of GPs and non-regular patients could be the subject of further research in the field of EHRs in general practice because the real benefit gained from using a system such as the Smart ID Information System, or any EHR system, is for GPs, who are normally unable to gain access to non-regular patient clinical diabetic data as indicated in Figure 1.1 earlier in the chapter.

Strengthening efficiencies of GP clinical work practices is beyond the scope of this project.

1.4.3.2 Limitations of the research

The original research plan comprised two comparative research sites: GPs located at The Entrance and Woy Woy, NSW, Australia, and GPs located in the Illawarra region of NSW, Australia. However, obtaining the commitment of GPs at The Entrance and Woy Woy proved problematic. It was decided to confine the study to the small group of GPs in the Illawarra, NSW, Australia.

While the researcher considered the inclusion of additional Illawarra GPs, the target group of GPs (and patients) engaged for the Smart ID Information System project, of which this study was administered under, was decided by IDGP to include the GPs and patients involved in IDGP's Diabetes Research program. These GPs and patients,

although a small sample size for research purposes, were considered suitable by IDGP for two reasons. Firstly, they were a cohesive group of general practitioners whose diabetic patients present regularly. Secondly, the GPs were comfortable with using computer technology. From the patient's viewpoint it was comforting for them to know their GP was also involved in the research.

The results of the research are from a small study. They may not be representative of the broader GP community. Consequently the results from the Illawarra GP community may not reflect the situation of general practice in other locations.

Within the group of GPs in the Diabetes program, difficulties were experienced in securing GP participants for the research on GP clinical work practices. Once GPs agreed to participate in the research, retaining their commitment to the research was also problematic.

Performance of the Smart ID Information System itself posed biases on the results of the study because the system took a long time to load on the GP's computer. The impact of this system performance on GP work practices during consultations is discussed in detail in the results chapters.

1.4.4 Research Design

1.4.4.1 Project Plan

The following project plan diagram shows graphically how the project was organized. It encompasses a perception study, an observation study and the use of secondary data.

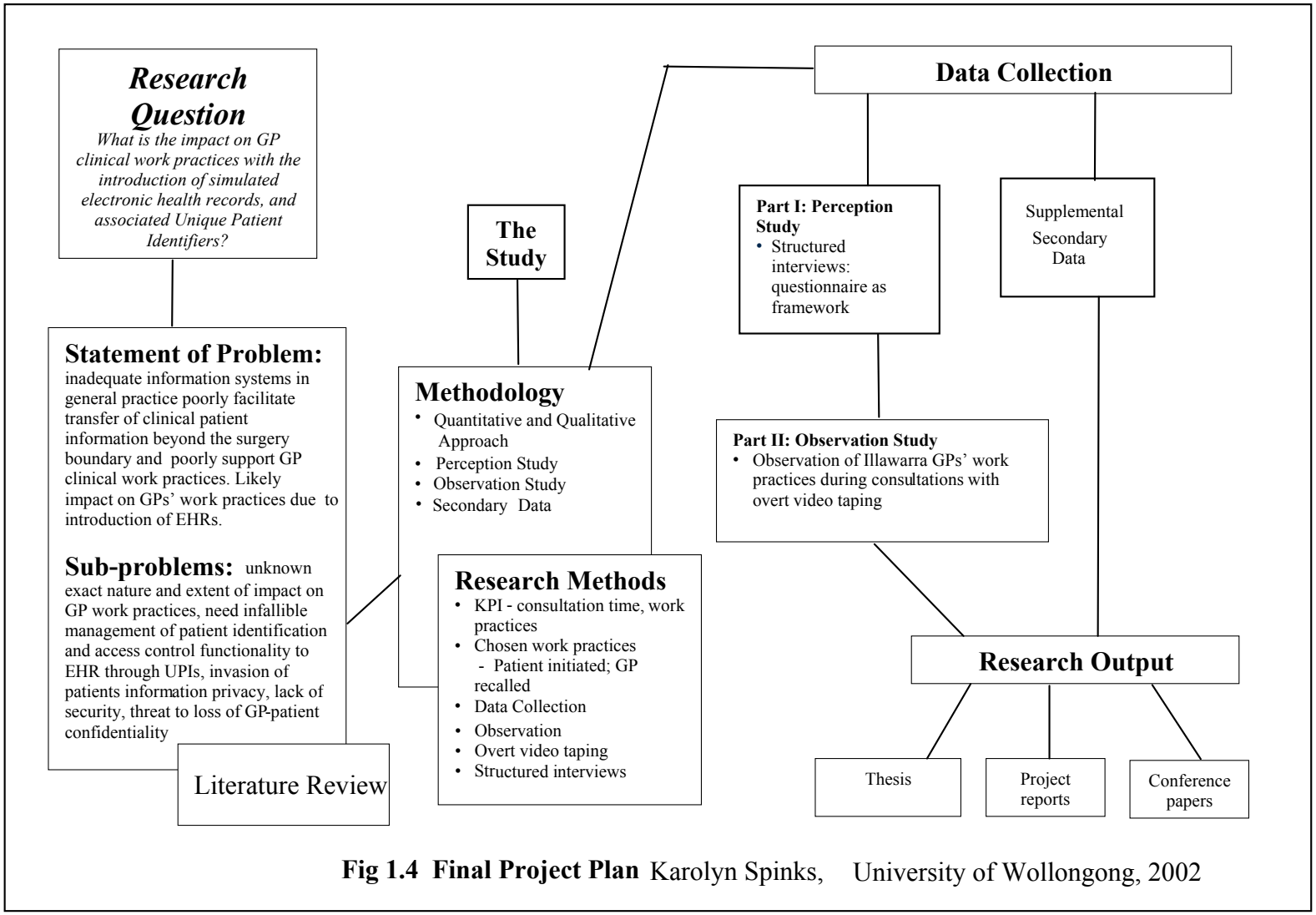


Fig 1.4 Final Project Plan Karolyn Spinks, University of Wollongong, 2002

1.4.4.2 Clinical Work Practices

Choosing which clinical work practices to focus on was determined through discussions with staff from IDGP. Two specific key performance indicators of clinical work practices were examined in the study. These were change in work routine and consultation time.

Secondary data in the form of a 2001 report on GP clinical work practices containing workflow diagrams (Appendix G) was used to guide the choice of which clinical work practice areas were suitable for research. Analysis of these completed workflow diagrams resulted in the identification of two specific areas of GP clinical work practices for investigation relevant to the use of the Smart ID Information System in the general practice environment:

- recall visits for patients with Diabetes where the GP is not participating in Smart ID project.
- recall visits for patients with Diabetes where GP is participating in Smart ID project.

The former type of clinical work practice was used as a baseline, the latter, was used for comparison to that baseline.

1.4.5 Research Relevance and Justification

In November 1999, the Australian Commonwealth government formed the National Electronic Health Records Taskforce, to prepare a report on a national approach to electronic health records. Their report, A Health Information Network for Australia, was released and endorsed by health ministers in July 2000 (NEHRT, 2000). In recognising this issue of Australian healthcare system reform, the relevance and justification for this research is derived from the national and state agendas to develop better access to quality information in general practice for clinicians, health consumers and government agencies.

Expanding on the issue identified above, current medical record systems available for general practice, both paper-based and electronic, do not allow ease of access to other

patient medical records outside the surgery. Neither do they facilitate transfer of clinical patient information beyond the surgery boundary.

Existing work practice inefficiencies resulting from inaccessibility to patient clinical information is another justification for the research.

The research is relevant and justified by the indirect role that it has in relation to improved clinical management of diabetes. There is a need for improved management of chronic diseases, such as diabetes, as the occurrence rate of diabetes increases (Wise, 2001:1, in Jovanovski, 2002:3). Information technologies that manage patient clinical information are expected to make a significant contribution in the clinical management of diabetes because of the potential that IT has in simplifying, not only for general practitioners, but also for patients, the clinical diabetes task management in terms of clinical information management. Therefore, examining the impact of IT, particularly EHRs, in general practice, such as the Smart ID Information System, may lead to the improvement of such EHR systems, which may indirectly lead to improved clinical management of diabetes and better health outcomes for diabetic patients.

Finally, the research is justified through the examination of existing literature and the identification of a gap in the Australian general practice environment.

1.5 Thesis Overview

This thesis consists of seven chapters. Following this introductory chapter is the literature review, chapter two, which provides a summary of relevant existing documentation in the fields of information flow within the Australian Healthcare system, EHRs, impact of CPRs and EHRs on consultations, information privacy, security, patient authentication, anonymity and access control management. The literature review shows how the researcher's work relates to the current state of EHRs and clinical work practices in general practice. The literature review concludes by identifying the lack of research relating to the impact of EHRs on general practitioners' work practices in consultations.

Chapter three, Methodology, examines the elements that determine how and why the research was undertaken and clarifies the reasons for the approach taken. The chapter begins with a detailed description and justification of the research design. It provides alternative designs/methods which were canvassed. It then elaborates details of the method utilized for investigating each research component. The chapter concludes with a brief explanation of the likelihood of bias in the research.

Chapter four, Research Results, Analysis and Discussion of Perception Study, presents the results of the GP interviews from the perception study and provides an indepth examination and interpretation of these research results obtained.

Chapter five, Research Results, Analysis and Discussion of Observation Study, presents the results of videotaped GP – patient consultations and provides an indepth examination and interpretation of these research results obtained from the observation study.

Chapter six, Summary of all Results, General Conclusion and Further Research, summarises the research findings from both components of the study presented in the previous two chapters. The chapter aims to tie together the entire current research, linking how the research achieved its research aims and objectives. Lastly, the chapter provides suggestions for further research.

1.6 Assumptions

It is assumed the reader is aware of the Commonwealth Health*Connect* project in primary care and NSW Health's EHR*Net project in the secondary and tertiary care arenas. A summary of these projects is provided in Appendix B.

1.7 Conclusion

This introductory chapter identified the research problem and provided a description of a study to address that research problem. The problem definition will be used in conjunction with evidence from the literature review to build proof for the existence of a research gap and justification for the undertaking of the current research.

This chapter introduced aspects of the research project to establish the milieu for the remainder of the thesis. These included an outline of the research topic, and of the larger project – Smart ID Information System - within which this thesis sits, background to and statement of the research problem, and an overview of the study itself. A summary of the structure of the thesis as a whole was provided. A list of assumptions completed the chapter.

2 Literature Review

The primary purpose of this chapter is to address the need for the research in the problem area of how EHRs impact on GPs' work practices presented in Chapter one. Five main themes have been reported in the literature published relating to EHRs. These themes are the information flow within the Australian Healthcare system, barriers to use of IT in general practice, evolution from computerized patient records (CPRs) to EHRs including the impact of CPRs and EHRs on GPs' work practices during consultations. The fourth theme is benefits of EHRs. The final theme is challenges of EHRs. Each theme is discussed in relation to general practitioners use of and attitudes towards IT in consultations. A fairly broad approach to the literature review has been taken. This is to encompass the complexities of how, why, when and where EHRs fit into the workplace of GPs. The central theme of the literature review is the impact of CPRs and EHRs on GPs' work practices in consultations.

Establishing the background to understanding GPs' perceptions towards accessing and exchanging clinical patient information and their attitudes towards the introduction of EHRs, requires an explanation of the information flow within the Australian healthcare environment in which GPs' have historically and currently work.

2.1 Information Flow within the Australian Healthcare System

For many years the Australian healthcare industry, from primary care to hospitals, has been characterized with islands of information, poor infrastructure to retrieve that information and consequential inefficiencies in work practices and patient care resulting from inaccessibility to the required information (NHIMAC, 1999; NEHRT 2000). To a large extent information remains isolated in different stakeholders hands such as GPs, community care services, government health authorities, such as, departments of health. One reason for this isolated information is although GPs are knowledgeable about the health needs and incidence of disease and disability in their local communities, the clinical information systems in general practice are often inadequate and unsuited to facilitating transfer of clinical patient information beyond

the surgery boundary. Furthermore, they are not useful in assisting in the construction of a meaningful population profile. Therefore, there is a need to develop the flow of information and expand the use of IT in Australian general practice (National Health Strategy, 1992; GPB DHAC, 2000).

Another reason for this isolated information is a lack of interdisciplinary links and consequential lack of integrated patient care between GPs and other health service providers. This structure makes sharing of data and viewing patients' previous medical episodes extremely difficult.

These characteristics are signs of a fragmented healthcare system, a problem which is aggravated by disparate payers of healthcare system funding (GPB DHAC, 2000, p176). In fact Blight, (1998), in GPB DHAC, (2000, p176) argues that separate funding streams within the Australian healthcare system are the primary cause of fragmentation of the same. In relation to general practice, this fragmentation is manifested by the structure of the healthcare system (National Health Strategy, 1992; GPB DHAC 2000) in which not only is information flow impeded but where GPs themselves are isolated from hospitals, from government agencies and from each other.

2.1.1 Factors Impacting the Isolation of GPs From Hospitals

There are two prominent factors influencing the amount of contact GPs have with hospitals. Firstly, GPs are isolated from hospitals because of the historically long-term trend in Australia towards medical specialization, which still exists today. This trend towards medical specialization has made it difficult for GPs to obtain or retain hospital privileges; specialists developed and maintained exclusive structures to prevent encroachment of their hospital domain by non-specialists (National Health Strategy, 1992, p104; GPB DHAC, 2000, p4, 158). This is the case particularly in cities with teaching hospitals attached to university medical schools, less so the case in rural areas and absent in remote rural places such as Weipa, Far North Queensland. In these remote rural areas there may be only one doctor who is the GP and the hospital medical officer. This tendency towards medical specialization can result in a

breakdown of continuity of patient care when GPs are unaware of the treatment their patients receive in hospital (National Health Strategy, 1992, p104). In addition, coordinated care and holistic care is under threat if specialists fail to refer patients back to the GP for general practice-type care and if they refer patients on to other services without informing the GP (National Health Strategy, 1992, p36). Even in 2004 this situation still exists to a large extent, although in some areas is less problematic with the development of care planning, case conferencing, health assessments, and shared care in obstetrics and diabetes for example (GPB DHAC 2000, p324, 177).

The tendency towards medical specialization also leads to fragmentation of the type of medical services performed due to less opportunity to undertake procedural work outside general practice and, fragmentation of the healthcare system as a whole (National Health Strategy, 1992, p36; GPB DHAC 2000, p 158).

The second prominent factor influencing the amount of contact GPs have with hospitals is the relatively recent growth of ambulatory care within the Australian Healthcare system. In general, the growth of ambulatory care is being promoted by the Commonwealth government with the aim to significantly reduce in-hospital healthcare costs by reducing admissions to hospital for conditions that might be considered manageable in the community or preventable overall. Such conditions might be long-term complications brought on by poor glucose control in the management of diabetes. These include ischaemic heart disease, renal failure, cerebral vascular accidents, retinopathy leading to blindness, and peripheral vascular disease leading to amputations. These complications are largely preventable through good management of diabetes (Victorian DHS, 2001, p25). In summary, the more GP's patients stay out of hospital, the less contact the GP has with hospitals.

The growth of ambulatory care has specific relevance to general practice with the introduction of the Commonwealth government's Enhanced Primary Care Package, which encourages a team approach on the part of GPs. The package also fosters closer working relationships between GPs and other primary care and community support providers including ambulatory care providers. Focus is on preparation of

multidisciplinary care plans, multidisciplinary case conferencing and voluntary health assessments for persons over 75, or 55 for Aboriginal patients (Victorian DHS, 2001, p3).

Another initiative is the Victorian government's Primary Care Partnerships (PCP) Strategy. This strategy aims to unite primary care providers such as GPs, community nurses and allied health workers to better coordinate the delivery of primary care services. A key goal of the reform strategy is to reduce the avoidable use of hospital, medical and residential services (Victorian DHS, 2001, p31).

In summary, the literature states the two reasons why GPs are isolated from hospitals are firstly, medical specialization and secondly, the growth of ambulatory care. This isolation can inhibit the exchange of patient information between hospitals and GPs.

2.1.2 Factors Impacting the Isolation of GPs from Each Other

One reason GPs are isolated from each other is that GPs face competition from allied health service providers and specialists alike. The current system of payment to GPs on a fee for service basis does not encourage effective liaison and co-operative working relationships between GPs and other primary healthcare service providers, as is promoted for the growth of ambulatory care. This is because GPs are paid to provide specific services, rather than manage a patient across a whole period of illness. Therefore GPs may be reluctant to transfer or share patient data with other GPs. However, if continuity of care is promoted and health and community services become more integrated, then a team approach to general practice would be necessary to achieve this co-operative working relationship. A change to the payment system for medical services would also be required thereby giving GPs and patients the option of payment for ongoing care, rather than payment solely on a visit-by-visit basis (National Health Strategy, 1992).

By 1996-97 with the election of a new government, the general practice strategy was reviewed. It was agreed by the medical profession and the government, that although the fee for service payment system would remain central to renumeration for GPs,

other forms of payment for GPs would also be sought with an underlying aim of better integration of general practitioners' with the broader health care system and a focus on improved quality of health care delivery and health outcomes (GPB DHAC, 2000, p 27). The health minister at the time, Michael Wooldridge, declared

> "that all the issues of general practice could not be dealt with solely through fee-for-service and that outcomes and evidence-based medicine would be rewarded both directly through payments to individual practices and also through divisions of general practice"
>
> GPB DHAC (2000), General Practice in Australia: 2000, Canberra, ACT., p27

This commitment from Commonwealth Government level was further extended with establishment of the General Practice Strategy Review Group (GPSRG). The aim of the GPSRG was to review the ability of the early 1990 reforms in continuing to meet challenges facing general practice and to ensure strategies would be appropriate for the 21st century. There were 174 recommendations made; 168 are in the continuing process of being implemented. One of the key recommendations from the GPSRG's 1998 report was related to payment methods for chronic and complex illness. To facilitate better coordinated care of patients suffering from chronic and complex illnesses the report recommended alternate payment methods between governments, consumers and GPs be investigated (GPB DHAC, 2000, p 33).

Another key recommendation in GPSRG's 1998 report was related to information management and information technology (IM/IT). Firstly, that the realization of greater use of IM/IT was vital to support better IM in future clinical practice. Secondly, the establishment of standards was needed for general practice IS, particularly for an Australian health record architecture. These standards should include standards for communications, data dictionaries and data sets, terminology and coding systems, quality IM systems including a new Australian health record, and standards for prescribing and clinical support systems. Also, standards for security and privacy (GPB DHAC, 2000, p 34).

Review of the general practice strategy highlighted and endorsed the important pivotal role general practice has for the future improvement of the broader healthcare system and improvement for the exchange of patient health information.

In summary the isolation of GPs from each other may inhibit the exchange of patient information between GPs. Furthermore, better fee payment systems may lead to better information flow and sharing of patient data.

2.1.3 The Increased Need to Improve the Flow of Patient Information

The improved flow of patient health information via EHRs has become an important issue of discussion in Australia and internationally in recent years. This is because even in recent years multiple records still exist in incompatible formats for the patient in various areas of patient care including GP surgeries, pathology, hospitals and other areas (NSW MACPHI, 2000, p10). The increased need to improve the flow of health information applies internationally, in the health sector, for many reasons. In USA, Appavu (1997) claims the major reasons for the increased need for this improved exchange of patient health information include:

- a high degree of patient mobility where people travel for work and leisure purposes, visit multiple providers and are treated by multiple organizations (Davidson and Holtz, 1998; Appavu, 1997);
- the need to access a single comprehensive healthcare record from multiple locations;
- the need to minimize over servicing and duplication of procedures in order to reduce costs of healthcare delivery;
- the need for more efficient healthcare delivery; and
- the provision of support for continuity of patient care.

These reasons for improved exchange of patient health information apply to Australia as well. The Australian population is increasingly mobile, there is a strong need to reduce healthcare costs partially due to an aging population, and strong support for improved continuity of patient care (NEHRT, 2000, p10-11).

The following two sections examine barriers to use of IT in general practice and how these barriers are being overcome with driving forces forging general practice's clinical computerization. Examining this changing situation is helpful in understanding GP perceptions and attitudes towards accessing and exchanging clinical patient information and the use of EHRs in their work place. GPs are a large end user group whose work practices will be affected by the introduction of such technology.

2.2 Barriers to Use of IT in General Practice

Throughout the 1990s it was recognized there were problems with harnessing the potential of IT in general practice. In Australia one study that reported problems was by Dr J Cacek (1994). Cacek's (1994) research hypotheses included firstly, that the lack of widespread use of computers for CPRs in Australian general practice was related to a negative attitude to innovative technology by Australian GPs. Secondly, Cacek (1994) hypothesized Australian GPs had a technophobia when they needed to deal with computers. Thirdly, GPs negative attitude to computerisation was related to demographic factors which affected GPs themselves. Cacek (1994) undertook a medium sized comprehensive questionaire study, which included seeking GPs' attitudes towards using computers for medical records during GP-patient consultation. Cacek (1994) found some very interesting results supporting his hypotheses. His findings included GPs considered the current CPR systems cumbersome, requiring modifications before GPs would willingly use them. His major findings included variables that seemed to have the most influence on GPs use of IT: GP age, gender and degree of knowledge of computers. However Caceks' (1994) major findings were brief and there was no conclusion to his research presented in his thesis.

In discussing the barriers facing GPs using IT for clinical purposes in their surgeries, a 1998 report by the General Practice Strategy Review Group submitted:

> "The development and uptake of information technology in general practice has been gradual and the barriers significant. Key barriers identified by the review included the cost of computerization, the rapid changes in technology, the lack of agreed standards and the problems of

> introducing technological information management solutions into the daily work place of general practice. Progress has been further impeded because general practitioners could not foresee any benefit for their own practices while the potential efficiency and quality gains for both patient and governments were more obvious. Added to this was the perceived high individual cost in terms of time and money, the lack of visible and accessible support and training, concerns abut the lack of security and confidentiality of medical information, possible medico-legal issues and a general lack of computer use among other health care professionals."
>
> GPB DHAC, 2000, General Practice in Australia: 2000, Canberra, ACT., p 180

At this time many GPs viewed IT as an unjustified expense for which there was little direct benefit for them. They needed to be persuaded that IT had the potential to improve patient care, save time, save money as well as provide convenience and reliability (GPB DHAC, 2000).

Even as recent as 2003 some GPs still expressed negativity towards the introduction of IT into their practices seeing it as a hostile invasion (Health*Connect* Program Office, 2003, vol 3,part 3, p 18). Although pockets of negativity still exist, generally speaking over recent years this trend has started to change, becoming more positive. This trend change is due to improvements in technology and the provision of support to general practitioners for example, financial incentives from government. This trend is discussed in more detail in the section that follows.

2.2.1 Driving Forces Forging Clinical Computerisation of General Practice

There are three main driving forces behind the impetus to clinical use of computers in general practice:

1. the information and communication technology (ICT) industries and associated advancement of the technologies within their industries;
2. government bodies such as NSW Dept of Health, and Commonwealth Dept of Health and Aging;
3. advocate groups of GPs interested in health informatics such as General Practice Computing Group (GPCG).

Recent technological developments such as the proliferation of the Internet, improved patient clinical management software such as Medical Director, introduction of electronic Health Insurance Commission (HIC) payments, and growth of telehealth (Buckley P., et al, 1995; Lee J.S., et al, 2003) are all signals of improvement of ICT infrastructure in primary care sector. This development has also improved the limited communication and sharing of patient data within primary care and between primary and secondary and tertiary care sectors of the healthcare system. Various groups of vibrant GPs from professional organizations such as Royal Australian College of General Practice (RACGP), GPCG, and Divisions of General Practice also provide IT support and information to GPs via IM/IT projects investigating ways of improving information flows, education and conferences.

These improvements in ICT infrastructure in general practice persuade GPs even more to utilize electronic information management for clinical purposes. These improvements are facilitated by government financial incentives to GPs, such as the Practice Incentives Program (PIP), where GPs are rewarded in part for using prescribing software to generate prescriptions and for using email to transmit clinical information. Improved information privacy legislation and collegial support from GPs interested in health informatics, is evidence of the provision of additional infrastructure development.

Overall, this simple progression of the infrastructure development is encouraging GPs to utilise electronic information management for clinical purposes. Many GPs are becoming more prepared to embrace the challenges that lay ahead of them. GPs have proven their support for using IT through receiving pathology results electronically from pathology service providers, and compliance with the government Practice Incentives Program mentioned above. They have also shown their support for IT related changes with their employment of "HIC Online" (Health Insurance Commission Online) services where GPs submit patient medicare claims electronically (HIC, 2003). Furthermore, in the Illawarra, for example, many GPs participated in an experimental project known as "GP-gateway" between 2000-2001. "GP-gateway"

allowed GPs' to receive PAS (patient administration system) reports from Illawarra Area Health Service (now called South East Sydney and Illawarra Health) (IDGP 2001).

In summary, it appears GPs may be reservedly and reluctantly accepting the use of IT in their workplace. Although they may be realizing IT can support them in their clinical role as medical practitioners they still have mixed feelings about the further use of IT in their practices.

2.2.2 IT's Contribution Supporting the Clinical Role of General Practitioners

A report by the Australian National Health Strategy (1992) discusses how general practice in Australia relates to other healthcare services and how general practice in Australia might change in the future. It examines the major issues of general practice and presents a series of strategic reforms to it. One of the key reforms it recommends for general practice is the improved use of information technology in supporting the clinical role of the general practitioner. The 1992 report states a strategic approach is needed for the use of IT in general practice and that a high quality primary care information system is integral to the reform in general practice. The report states a key objective for a strategic approach to IT in general practice is to improve the use of general practice information systems by the creation of a database useable for assessing individual and population health outcomes of medical services. In order to achieve this objective it would be necessary to promote the patient record as the centerpiece of a primary care information system. It will also be necessary to encourage more local use of general practice information for quality assurance and health promotion.

In his book, `Guide To Medical Informatics, The Internet and Telemedicine' (1997), Coiera says that while information and communication technologies promise to revolutionise the delivery of healthcare, many clinicians including GPs are unaware of these information and communication technologies potential and limitations. He suggests there is a growing need for clinicians to understand the principles of informatics that influence clinical decisions and clinician behaviour. By knowing the

constraints of IS design principles, clinicians may better understand how IS and Communication Systems fit into the clinical workplace. Thus, they may work more comfortably with the inherent limitations of IS and Communication Systems.

In an effort to better meet consumers' needs with complex health conditions and to better manage the healthcare budget, coordinated care was trialed throughout Australia as part of the 1995 Australian government healthcare reform agenda (GPB DHAC 2000, p471). The aim of the nine commonwealth approved trials was to test if it was possible to achieve better quality care for consumers with complex and long-term healthcare needs while more effectively managing the healthcare dollar through exploring different healthcare financing models. General practice was seen as the ideal health sub-sector to play a central role in these coordinated care trials; for the reasons of GPs being the architects for change within the healthcare system (GPB DHAC 2000, p471).

While the results of the trials are beyond the scope of the research in this thesis, lessons learnt from the trials are relevant. In an example of one coordinated care trial which had at its core an EHR, (Dalley, 2001 in Commonwealth DHAC, 2001, p149-154), cautioned that while there was a perceived need amongst the stakeholders involved in the Illawarra coordinated care trial such as GPs, Community Health clinicians and the hospital casualty dept, to improve communication between health service providers and the sharing of patient health data the IT solution for this problem, in the form of an EHR, will only be successfully accepted when it is defined by the end user; that successful innovation only occurs with stakeholder involvement and enthusiasm.

2.2.3 Australian and UK Comparison of General Practice Clinical Computerisation

By 1991, Australian computerization of general practice for clinical purposes had been minimal. In contrast, for the same period, UK IT infrastructure in general practice for clinical purposes was well established. By the end of 1991, 80% of UK GPs were expected not only to have computers but also to be actively using them for clinical purposes such as preventive health and electronic prescribing (Hayes, 1993, in Cacek,

1994:4). This difference between the UK and other western countries was verified by Roberts (1991, in National Health Strategy, 1992: p151), who says, in comparing the situation of Britain and USA that

> "Most United States group practices have been using computers for nearly a decade – for billing and latterly, for patient registration. What is revolutionary is how British general practitioners are using them [computers]. At the Lombard Street Surgery, Newark, for example, each GP has available within a few seconds medical histories, prescription histories, patient risk factors, recall letters, programmes to write repeat prescriptions, drug interaction databases, vaccination and laboratory records, demographics and prevention reminders – all via the computer on their desk"
>
> Roberts J., (1991) in National Health Strategy, 1992: The Future of General Practice – Issues Paper no. 3 p151

Difference in support for use of IT in general practice between Australia and the UK is partially related to the different practitioner payment methods – capitation grants of so much per patient on the basis of registered patient lists (Regan, 1991, in National Health Strategy, 1992). Other factors promoting the use of IT in general practice in the UK included the provision of substantial government funds to purchase and maintain computer hardware and software and data entry (Roberts, 1991, in National Health Strategy, 1992). The development and endorsement of the Read Clinical Classification System by the British government enabled data aggregation beyond the surgery. It also fostered use of computers for clinical purposes in general practice.

By 2002 Britain's dedicated NHS network service (NHSnet) was reported to be working as stated in a British government white paper, The New NHS (Chadwick et al, 2000). The NHSnet links IS in primary, secondary and tertiary care to improve the flow of information between these healthcare sectors.

2.3 Evolution from Computerised Patient Records to Electronic Health Records

Computerized patient records (CPRs) are the predecessors to the more recent EHRs. In general CPRs are different to EHRs in that they are not networked or if they are the network is localised to computers within a surgery or division(s) of that surgery. A

large mass of literature exists on CPRs. For the purpose of this thesis, which focuses on EHRs and their impact, only some of the literature on CPRs has been presented here. This is for the reasons of providing background to EHRs and because use of CPRs provide an indication of the impact of computers in general practice. A third reason is to retain EHRs as the foremost topic.

Since 1969 there has been worldwide discussion of CPRs (Weed L., 1969; Basden and Clark, 1980; Akerman, 1984; Ball and Douglas, 1992). Akerman (1984) reported benefits of a clinical CPR system used in a UK general practice, which improved the surgery's patient records and revolutionized the way the practice managed their repeat prescriptions and recalled their patients for items relating to screening, and illness prevention, such as marginal hypertension, cervical cytology and immunization. Although this early discussion of CPRs focused on the idea of computerisation of paper-based patient records, the discussion pioneered the way for evolution to the more recent concept of EHRs. Indeed Akerman (1984) argued that the potential of the CPR system was enormous as long as political implications of nationwide exchange of patient information could be controlled.

By 1993 evidence of early efforts of EHRs in Canada were being reported with Liaw and Chan's paper on MUFFIN (McGill University Family Folder Information Network). Liaw and Chan (1993) gave an overview of an early version of a networked CPR system: MUFFIN, an MS-DOS clinical CPR system developed in Montreal, Canada. Originally designed as a single user, encounter-sheet based system, MUFFIN developed into a networked system where patient information was viewed and updated instantly. Liaw and Chan (1993) suggested all components in healthcare IS should be standardised to allow community-based systems to communicate well with secondary, tertiary and other related healthcare IS. Even at this rather early time of 1993 MUFFIN incorporated International Classification of Primary Care (ICPC) philosophy and utilised ICD-9 & 10 clinical coding framework.

There now exist many nationally significant initiatives with EHRs worldwide (Cornwall, 2002). For example, NHI/MWS (New Zealand), EHR-S, MS_SHARE (USA),

EPR/NHSnet (UK), Infoway (Canada), Smart Systems for Health (SSH)/ePhysician (Ontario, Canada), HealthNet/PharmaNet (British Columbia, Canada), Pharmaceutical Information Network(PIN)/Wellnet (Alberta, Canada), Health Smart Card (Germany), RSS/Sesam-Vitale (France), EPR System (Ireland), EHR system (Finland). Cornwall (2002) discusses many of these projects in comparison with Australian initiatives HINA/Health*Connect* and NSW EHR*Net. An awareness of all these initiatives is useful for understanding recent international attention given to EHRs. However, only Australia's HINA/HealthConnect, NSW EHR*Net and UK's NHSnet have been reported in detail in the thesis. This is to provide background information relevant to the current research.

The next section, section 2.3.1 'Impact of CPRs, EHRs on GPs' work practices during consultations is a central theme to the current research. It provides direct evidence of GPs' concerns in using IT during consultations and changes in their work practices from doing so. It also shows how GPs' work in a technology dependent environment.

2.3.1 Impact of CPRs and EHRs on GPs' Work Practices During Consultations

An authoritative Australian report by Heard and Grivel et al (2000 p36) declares the capacity to share patient data in EHRs with other systems, such as radiology, may lead to real efficiency improvements in work practices for health service providers including GPs. A second assertion made by Heard and Grivel et al (2000 p33-35) was these more streamlined work practices can lead to improved health service provider productivity, work satisfaction and quality of healthcare delivered. Heard's and Grivel's et al's (2000) report was based on an extensive literature review focusing on the benefits and difficulties of a national approach to EHRs in Australia. Despite these assertions Heard's and Grivel's et al's 2000 report did not give specific details of how improvements to work practices occurred.

Other studies on the impact of CPR and EHRs on GPs' consultations identified issues with GPs' perceived loss of ability to control the consultation (Emery et al 1999), concerns with length of consultation (Emery et al 1999, Health*Connect* Program Office

2003, vol 3, part 3, p18) and detrimental impacts on for example, GP/patient rapport (Leung et al, 2004). However, these studies also identified positive findings such as small extent of change to GPs' work practices (Health*Connect* Program Office 2003, vol 3, part 3, p68) and a generally positive GP attitude to the impact of clinical computerization (Leung et al, 2004). The studies are discussed in more detail below.

A study that reported impact of computers on GPs' consultations was by Emery et al (1999). Emery et al (1999) qualitatively explored GPs' attitudes towards and use of an IS for patients' genetic risk assessment of cancer in primary care. The study identified important issues relating to the use of computers in consultations. Emery et al (1999) reported GPs found the IS easy to use but it affected their control of the consultation due to prematurely sharing sensitive information generated by the genetic risk assessment report with patients. GPs were uncomfortable with this because they felt a loss of control with patient communication. They felt they had an inability to anticipate the information content that would be displayed on the computer screen. GPs felt they needed to balance their desire to share the computer screen with the patient, motivated by concerns about the effect of the computer on doctor-patient interaction during the consultation, with the risk of premature disclosure of bad news to the patient.

Concerns about length of consultation emerged as key issues from Emery et al's (1999) study also. Consultations ranged from 10-25 minutes depending on the GP's computer skills and patient's responses to questions. This lead the GPs to proposing various time management strategies such as double appointments, dividing the consultation into stages or delegating data entry for the risk assessment to a practice nurse thereby enabling assimilation of the report in the patient's absence.

Concerns about length of consultation also emerged as a key issue in the Health*Connect* Tasmanian trial (Health*Connect* Program Office, 2003, vol 3, part 3, p 18.) The GPs in the trail would not use Health*Connect* because the EHR system increased the length of consultation (Health*Connect* Program Office, 2003, vol 3, part 3, p 18.)

Emery et al (1999) cautioned against underestimating the potential negative impact of computers on the consultation. Emery's et al (1999) study suggested several stages of careful evaluation when designing medical IS in order to reduce negative impacts of the program on the consultation are needed. These include how the software functions and its impact on users, patients and the health system. Emery et al (1999) believes the issues from the study, identified above, are relevant to the wider use of computers in general practice.

Another study that reported impact of computers on GPs' consultations was by Leung et al (2004) in Hong Kong. Leung et al (2004) identified a generally positive physician's attitude towards the impact of clinical computerisation with respect to the doctor's increased ability to manage complex health problems and interactions within the healthcare team. Leung et al's (2004) study also highlighted three areas in which doctors indicated detrimental impacts of clinical computerisation: the effect on rapport between doctors and patients; human side of the practice of medicine and personal and professional privacy. Although statistically robust, Leung et al's (2004) study findings were limited as the research was conducted using a hypothetical setting. Thus the stated responses may not guarantee agreement with real life actions (Leung et al 2004).

The most recent Australian evidence of the impact of EHRs in general practice is from the Australian Health*Connect* trials. Significant effort went into undertaking these trials – two trials have been completed, three are continuining. At the time of writing this thesis, limited findings from these trials were available due to many reports not being released from the Commonwealth Department of Health and Aging (Chatchatoor, 2004 in Health*Connect* Program Office, 2004).

The Tasmanian Health*Connect* trial published preliminary findings on the extent of change to general practitioners' work practices (Health*Connect* Program Office, 2003, vol 3, part 3, p68). This change management topic was one of the subsidiary research questions asked of the trial. The extent of change to GPs' work practices was reported to be

> "small other than the need to routinely obtain consent to send event summaries to Health*Connect*. The modifications to [patient management software] Medical Director, have provided an effective seamless interface for linking to Health*Connect* and for the submission of event summaries."
>
> (Health*Connect* Program Office, 2003, vol 3, part 3, p68).

It was unclear in the report if this finding was opinion obtained from GPs themselves or opinion from the Tasmanian Health*Connect* trial evaluators, or of report author(s). This finding assumes that the GP was already using Medical Director. However, if a GP was not already using Medical Director, or other patient management software, then the changes in work practice may likely be substantial. GPs would need to learn how to use patient management software as well as how to use Health*Connect* software. In fact 40% GP respondents in the trial felt Health*Connect* software was challenging to use (Health*Connect* Program Office, 2003, vol 3, part 3, p31).

Impact on interpersonal interaction between GP and patient during consultations using EHRs was reported from the Tasmanian Health*Connect* trial (Health*Connect* Program Office, 2003, vol 3, part 3, p55). However this aspect was reported from the viewpoint of the patient. No results relating directly to this aspect were available from the GPs' viewpoint. Most patients indicated use of the computer for EHRs during consultation did not distract the GP from conducting the consultation. Indeed, the opposite was reported by patients, reflecting patients' increased awareness of use of IT in modern medicine. Patients indicated they expected computers to be used during the consultation. Secondly, they valued the use of the computer to present EHR information and expected consultations to be more professional and efficient through the use of the Health*Connect* EHR system (Health*Connect* Program Office, 2003, vol 3, part 3, p55).

2.4 Benefits of EHRs

It has been widely suggested EHRs are conducive to providing a more complete consumer record compared to traditional paper-based record systems or locally stored CPRs (Chadwick 2000, NEHRT 2000, Heard & Grivel et al 2000, Health*Connect*

Program Office 2003 Vol 1 p44). A more complete consumer record may facilitate the creation of a more complete and/or more accurate medical diagnosis. This idea is supported in the report by NSW MACPHI (2000 p 17), which states EHRs would provide health service providers with ease of access to a more detailed consumer health record. This may then foster decision support regarding diagnosis or treatment. Additionally, EHRs may improve consumer health outcomes by better facilitating the provision of coordinated and continuous care. Woolridge (2000) provided support for EHRs from a national government level stating Health*Connect* presented a substantial opportunity for both health consumers and providers to improve health care in Australia based upon expected benefits. Woolridge endorsed the 2000 report by NEHRT.

The merger of records in EHRs allows easy access to the patient's more complete medical history (provided patient consent is obtained) from a single point of care. NEHRT (2000 p XVII) and Heard & Grivel et al (2000) claim this merger of records not only saves healthcare providers' time, effort and reduces the feeling of frustration when using the cumbersome manual tracking and transferring of existing fractional records, but merging of records also enables better coordination of care, eliminates unnecessary duplication of diagnostic tests and minimizes the potential for medical misadventure.

Stein (1997) argues EHRs provide consistency and flexibility through standardized and manipulable patient data. These benefits liberate the provider from interpreting non-standardised notes from fractional records. Flexibility of manipulable patient data means, for example, notes and results from multiple unrelated medical conditions can be organized so that, for example, a patient's struggle with cardiac disease is not interrupted by notes pertaining to the patient's gynaecological, and dental problems. A single laboratory result, such as serum potassium level, may be extracted and charted over time (Stein 1997). Flexibility of the EHR also allows a problem-oriented approach to medical record keeping (Stein 1997). Not only can health service providers promptly focus on the medical problem, which concerns them, but the

standard of care required for each problem may be more easily assessed for quality assurance purposes. For example, frequency and type of cervical screening for a cancerous or precancerous condition (Stein 1997).

In their report, 'The benefits and difficulties of introducing a national approach to electronic health records in Australia', Heard and Grivel et al (2000, p 23-38) suggest one of the benefits of EHRs include improved and appropriate access to patient health records drawn from the capacity to share patient data. This may lead to less frustration and real improvements in work practices for health service providers. A second benefit Heard and Grivel et al (2000) suggest is improved health service provider support via providing patient information for personalised patient decision support systems, access to high quality online information such as electronic therapeutic guidelines. A third benefit relates to improved overall efficiency and quality of healthcare provided. This benefit Heard and Grivel et al (2000) report arises not only from removing the shortcomings of paper-based practice but from streamlined work practices that leads to major benefits with improved health service provider productivity and satisfaction. This benefit includes improved information flow not only between GPs and hospitals but also from supporting systems such as radiology, pathology and specialists. Resultant better clinical decision support for health service providers through their improved performance may foster the realization of improved provision of quality healthcare (Heard and Grivel et al 2000).

Support for EHRs for improving health service provider productivity and satisfaction is reported by Heard and Grivel as:

> "The ability of the EHR system to provide user dependent data layout, assisted search as well as more output methods (screen, paper, email, fax etc.) and tailored output all aid productivity"
>
> Heard S., Grivel T., et al (2000), The benefits and difficulties of introducing a national approach to electronic health records in Australia. Section 4.6.2, p 34

Stein (1997) explicitly identified advantages of EHRs for GPs. Stein (1997) argued the ability to remotely access EHRs is a significant advantage for GPs. Traditionally GPs

have been kept little informed about their patients' treatment whilst in hospital. At best they may get an electronic discharge summary after the event. At worst they may be totally unaware of the patient's presentation to hospital. With EHRs, given that they have the patient's consent, GPs may now review the daily hospital notes and treatment plan. They may even be able to actively participate in their patient's management care plan (Stein, 1997).

Contrary to Stein's work one Australian study found there to be little benefit for GPs from EHRs (Jovanovski, 2002). Jovanovski (2002) evaluated the trial of the Smart ID Information System outlined in chapter one - a scaled-down EHR system which was tested in a controlled environment. Jovanovski's (2002) findings included that although the Smart ID Information System was functional, GPs involved in the trial could not identify benefits for themselves from the system at that particular time because the information in the system was too limited. Jovanovski (2002) reported that this absence of perceived benefits suggested GP satisfaction level with the system was low due to the narrow scope of the system. However, the GPs indicated that if the Smart ID Information System was extended to incorporate medical specialists such as endocrinologists, or hospital A&E departments, or other GP surgeries such as medical centers, the system would then have great benefits for them as general practitioners (Jovanovski, 2002, p 78). Thus the level of benefit and perceived satisfaction with EHRs by GPs is dependent to a large extent on the degree of connectivity – the more medical professionals and patients using the system, the greater its value. Level of benefit being dependent on the degree of connectivity is reported, by Heard and Grivel et al (2000 p36) as having an important implication for the national approach to EHRs in Australia. Heard and Grivel et al (2000 p36) state if the national approach is followed then a certain level of implementation must occur to achieve benefits of efficiency and thus improving health service provider satisfaction and productivity.

Success of IS such as EHRs in part depends on how useful GPs perceive them. EHRs need to be acceptable to GPs and also easily applied in clinical practice in order to be perceived to be truly useful. Therefore, to fulfill GPs' needs in working with EHRs it is

important to obtain GP views relating to the usefulness of EHRs and assess the impact EHRs may have on the way GPs' work.

Furthermore EHRs bring with them certain challenges. The current research seeks to find how these challenges impact general practitioners' work practices. Key challenges and their impact are discussed from this point forward in the literature review.

2.5 Challenges of EHRs

Despite the reported benefits of EHRs that are likely to lead to the improved delivery of health care services, there are reported challenges of EHRs (NSW MACPHI 2000, Stein 1997). These challenges range from ethical, social and legal issues such as confidentiality and information privacy to technical issues such as security, reliability and accountability. Mismanagement of these issues places patient health information at risk of being inaccurate, misused or disclosed without authorisation. This information mismanagement may negatively impact on GPs' acceptance of EHRs because GPs' work practices may be too much adversely affected. The negative impact may also extend to how GPs relate to their patients during consultations.

Information privacy, confidentiality and security are intimately related to use of EHRs in general practice and how GPs' work. Therefore they are addressed closely in the current research. Although closely related, security, confidentiality and privacy are strongly different concepts. Privacy involves the right to be left alone and undisturbed (Sykes 1976, p881). Confidentiality involves being charged with the task to protect an individual's information from disclosure (Sykes 1976, p212). Security does not necessarily lead to privacy because trust must be considered in privacy protection. The relationship between security and privacy is described as:

> "The concepts of security and privacy in health information systems are distinct but inextricably linked, like Siamese twins. The distinction can be expressed as follows: security is the protection of computers from people, and privacy is the protection of people from computers. The maintenance of privacy and security are two of the goals of a health informatics system"
>
> (Robinson, 1994 in Hovenga E., et al, 1996, p 77)

American Psychiatric Association (APA) (1999) reports invading patients' privacy may ultimately endanger the quality of health care. The APA (1999) also cautions that EHRs may pose a threat to the therapeutic doctor-patient relationship, and the loss of confidentiality for practitioners and patients alike. Patients may potentially withhold information from the health service provider or even stop seeking medical care because they perceive the information may be accessed by other non-authorised personnel, such as employers or government departments.

Many GPs are committed to the protection of patient information privacy, achieving this through quality management of their data, processes and work practices. This commitment to patient information privacy may offer little consolation to patients providing sensitive health informaton. For example, many GPs use current industry standard techniques and processes, such as secure socket layer (SSL) data encryption and authentication, when electronically transferring patient information to ensure that personal patient information is kept secure and confidential. In addition, effort is also made to ensure the security of a GP's practice, including secure physical housing, and computer system hardware and software security components. However these security endeavors may offer little reassurance to patients because of the intangible nature of electronic data transmission used in EHRs.

The threat to personal information privacy has been reported as a serious problem of EHRs (Stein 1997; NSW MACPHI 2000). Stein (1997) states if EHRs are distributed via the internet, the real problem is not lack of security measures during transmission as the same technical measures used to protect financial data can be used to protect health information. The real problem includes the following two aspects. Firstly, is the difficulty in defining "authorized medical practitioner", Stein (1997). The health care sector is vast and every employee is potentially an authorized practitioner. Secondly, the curious nature of humanity means that health information may be used for his/her advantage, or others' disadvantage Stein (1997). In his 1997 paper Stein reported a conclusion given by a discussion panel appointed by the U.S. National Research Council that the real threat was the extensive and unfettered sharing of health

information among the many branches of the health system including insurance companies, health service administrators and government agencies. Stein (1997) recommended that to combat the information privacy challenges and associated ethical and social ramifications connected with EHRs, well-considered legislation was needed that provided guidelines outlining how health information should be used, who should have access to it and what parts should be made available. Only then can EHRs be allowed on the internet (Stein, 1997).

In contrast to Stein (1997) NSW MACPHI (2000) identified a main concern regarding information privacy when consumers' EHRs are transmitted. NSW MACPHI (2000) reported the risks surrounding electronic transmission poorly positioned consumers and providers in knowing exactly who was accessing the personal health information.

Both Stein (1997) and NSW MACPHI (2000) identified the need for legislation to protect both patients and health service providers including GPs when using EHRs. The report by NSW MACPHI (2000) stated there was a need for the development of more stringent restraints and safety measures, including specific, new health information privacy legislation that inclusively covered health information privacy for all people who used EHRs. GPs and their patients are a large group of users affected by privacy implications in EHRs. The new legislation, if introduced, according to NSW MACPHI (2000) would aid in fortifying consumer trust in a healthcare system based on EHRs. Furthermore, the NSW MACPHI 2000 report suggested the new legislation must cover all health information, no matter who created it, or who owned it or maintained it. Resultant legislation at a state level, the NSW Health Records and Information Privacy (HRIP) Act 2002 followed as recommended by NSW MACPHI. This legislation is discussed briefly in the next section to indicate the legislative measures taken to maintain patient information privacy during consultations and beyond. The legislation's relevancy to the current research is linked by the fact EHRs facilitate sharing of personal information over a wide network of people, and thus potentially conflict with information privacy principles in a number of ways, particularly during consultations. Information privacy principles need to be

embedded in the operational design of EHRs. Everyone using EHRs, including GPs, must have a common understanding of their privacy obligations. Furthermore, because EHRs are accessed and generated during patient-GP consultations, the issue of information privacy is foremost in both the patient's and GP's thoughts and actions (GPB DHAC, 2000, p180). NSW MACPHI (2000, p 27), says patient confidence in EHRs would be increased by this improved legislation. This improved confidence in EHRs may help to alleviate some of GPs' concerns in adopting IT in general practice as identified earlier in the literature review in section 2.2 "Barriers to Use of IT in General Practice".

In the following section further evidence is provided of measures taken to manage patient information privacy in a healthcare system with EHRs. Such steps aim to maintain high quality doctor-patient relationships during consultations and beyond. The adequacy of Australian and State information privacy legislation in responding to the challenge of privacy invasion due to EHRs is also discussed.

2.5.1 Impact of Information Privacy Legislation on GPs' Work Practices

To better protect ones privacy, the Australian government recently developed the National Health Privacy Code to provide a common standard for all Australian and State/Territory governments to adopt (Woodhead, 2002, in Cornwall 2002, p 4). This National Health Privacy Code was designed specifically for health information in both private and public sectors – the sectors whose information boundaries are crossed with EHRs. The Commonwealth Privacy Amendment (Private Sector) Act 2000 was used as the basis for the code. The act came into effect on 21st Dec 2001 (Bennett, 2001, p415). Indeed the National Health Privacy Code has already been used by the Australian government's Health*Connect* project to underpin consent and privacy for GPs during the project's trials (for example, in the Tasmanian Health*Connect* trial). The act has implications for the use of EHRs by GPs because it provides patients with rights of access to their health records including EHRs held in private practice. Such patient access to medical records in private practice was never permissible before (Bennett, 2001, p415). Thus, this legislation may be

disruptive to consultations or may change the way GPs interact with their patients during consultation and is directly relevant to GPs' work practices for these reasons.

As mentioned in the previous section, 2.5 'Challenges of EHRs', the NSW government responded to the information privacy issue with its own legislation: the new NSW Health Records and Information Privacy (HRIP) Act 2002 which has been developed to accommodate EHRs. This new act enhances existing NSW information privacy law. The NSW HRIP Act 2002 is the first NSW act that covers both public and private sectors by the same information privacy legislative regime. Davidson (2004) suggests this broader coverage should provide more legislative consistency for health consumers. Furthermore GPs are also bound by and protected by this law. Therefore the existence of this legislation may also boost GPs' confidence in using EHRs and help to alleviate some of their concerns in using IT are mentioned above.

Other measures taken to manage patient information privacy in the health sector are firstly the NSW Department of Health development of an 'Information Privacy Code of Practice' (Bennett 2001). This code has recently been amended to reflect EHRs. Secondly, a measure taken by RACGP is the 'Handbook for the Management of Health Information in Private Medical Practice', 1st edition, October 2002. This handbook was developed by RACGP as a best practice model to assist GPs in complying with their legal and ethical obligations in relation to the privacy and confidentiality of personal health information (RACGP 2002).

This section has highlighted changes that new Australian and State level information privacy legislations and codes will bring to general practice in light of EHRs. The new laws also introduce stringent restrictions and serious penalties for non-compliance and prevents, for example, the on-selling of personal health information. Thus, personal health information is not legally available for aggregation with other personal information. This restriction effectively avoids the development of detailed personal dossiers therefore helping to maintain health consumers' information privacy. GPs using EHRs need to be aware of these restrictions and penalties so they can reassure patients of concerns during consultations.

These above mentioned recent improvements to privacy legislation in NSW and Australia wide aid in strengthening the acceptance of EHRs into general practice for GPs by allaying patients' concerns (Bennett 2001 p416) and by facilitating healthcare delivery by GPs' within and across professional, organizational and jurisdictional boundaries (NSW MACPHI 2000 p26). The legislative improvements are a necessary preparation for the introduction of an integrated National Healthcare System based on EHRs, such as Health*Connect*, that provides health consumers and health service providers with control over the collection, storage, use, disclosure, handling and management of personal health information (Health*Connect* Program Office 2003, vol 2, rpt 5, p1-30).

Finally, both the uptake of EHRs in general practice and the nature of GPs' work practices are very much dependent on the privacy legislations because GPs must adhere to their legal and ethical obligations while doing their work. Patient and GP confidence that patient information will be kept secure, confidential and private is likely to reflect the usage of EHRs by GPs. GPs who adopt EHRs will be obliged to abide by these new privacy codes and laws in their everyday work practices (Health*Connect* Program Office 2004, p57). Thus the introduction of EHRs is likely to impact the way GPs' work.

2.5.2 Patient Authentication and Anonymity with UPIs

An important component of an EHR system is the unique patient identifier (UPI). The UPI number is the mechanism used to link patient records together. The UPI is also the mechanism to ensure accurate patient authentication between the patient in the doctor's presence and the EHR being accessed. NSW MACPHI (2000, p10) states without a UPI, there is no reliable way of uniquely identifying patients' EHRs. Presentation during the consultation of a patient held device which contains the UPI (such as a smart card, I key, or other device) is likely to be the procedure used by patients to grant GPs patient consent to access patients' EHRs. Thus, GPs' work practices during consultations will likely be affected by the use and management of

UPI devices due to this new procedure. The Health*Connect* Program Office (2003, vol 3, prt 3, p68) states when GPs use EHRs their work practices will change due to the need to routinely obtain a patient's consent to access that patient's EHR.

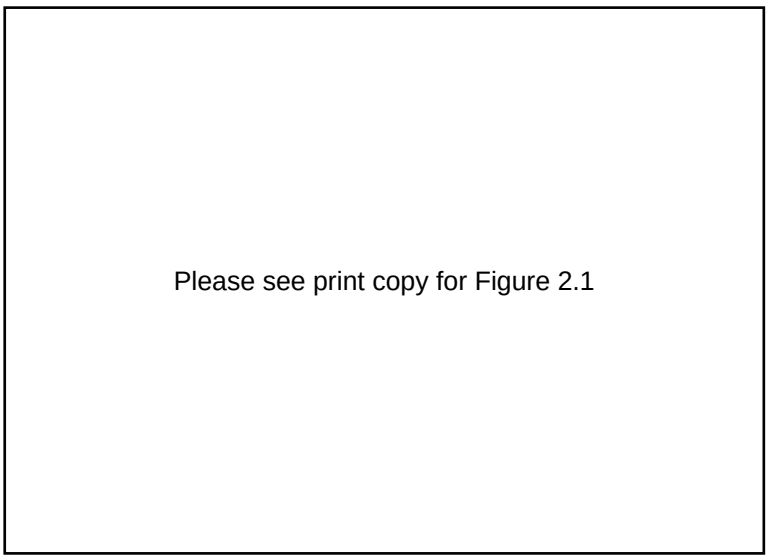
In terms of privacy during consultations, the patient may feel threatened by a perceived loss of privacy when issued with a device containing a UPI with which their EHR can be accessed during such consultations. For this reason it is imperative that electronic access to patient records and sharing of patient information is driven by the patient's right to grant consent for access by others (NSW MACPHI 2000 p 33). Australian initiatives such as Health*Connect* (Health*Connect* Program Office, 2002, p27) have adopted this patient driven approach for this very reason. The patient may opt into or out of the EHR system voluntarily and feels empowered by exercising their right to do so.

Another implication of UPIs is in some situations UPIs may eliminate the patient's anonymity because they cannot claim to be another person. For privacy reasons some patients do not like to divulge their identity and for legitimate reasons may need to or prefer to access health services anonymously. A report by NSW MACPHI (2002 p37) emphasized the use of a UPI must not deter the offering or the uptake of current and future health services provided and used on an anonymous basis.

Appavu (1997, p9) suggests issues of confidentiality, privacy, and security do not preclude the use of UPIs in EHRs but rather slows the introduction of UPIs and EHRs until issues of confidentiality, privacy and security are addressed satisfactorily and the necessary infrastructure established. Appavu (1997) says that UPIs are accepted by many stakeholders as an integral part of patient care because UPIs are needed for identification of patients in clinical procedures and administrative functions. In addition, UPIs are accepted by many stakeholders as an integral part of patient information because they are vital for automated management of patient information.

Support of UPIs is also reported by NSW MACPHI (2000). The report found that in order to maximize the benefits from EHRs and sharing of consumer information

between health service providers, a UPI was needed to easily allow linkage of existing separate CPRs. The report highlighted the UPI must be used to join only separate CPRs and no other personal non-health data unless clearly defined by law. This restriction must be explicitly stated in the development of new health information privacy legislation. Lastly NSW MACPHI (2000) said the UPI must be superior in functionality to allow exact electronic health record matches and proof of individual identity. Figure 2.1 below shows an example of a simplified probabilistic matching algorithm used in UPIs by NSW Health in secondary and tertiary care.



Such a probabilistic algorithm allows fields to be evaluated for the degree of match. A number is assigned to each field which represents the informational value contributed by those fields; the numbers are summed to derive a total score that measures the statistical probability of a match (NSW Health 2003).

2.5.2.1 Access Control Management with UPI s

The NSW government's introduction of EHRs and UPIs in secondary and tertiary care has helped pave the way for the successive introduction of similar technology in primary care by Health*Connect* (NSW Health, 2003). Regardless of whether it is primary, secondary or tertiary care, access control management of patients' EHRs requires careful consideration not only from a management viewpoint but also from a security viewpoint. One report from the Health*Connect* Program Office on the Tasmanian

HealthConnect Trial identified the audit trail of access to the patient's EHR was available in print format on request (HealthConnect Program Office, 2003, vol 3, part 3, p 12).

2.5.3 Security Considerations

Security is a widely reported major issue regarding electronic access to a patient record from any location, including general practice (Bakker 1998, Barber, 1998, Gritzalis and Lambrinoudakis, 2004). One reason begetting this in an EHR system is the dramatically expanded universal group of non-authorised people who may intentionally or unintentionally damage the EHR system (Gritzalis and Lambrinoudakis, 2004). Security of information exchange is vital to ensure patient privacy and confidentiality, data integrity, data availability and data access (Bakker 1998, Barber, 1998).

Bakker (1998) states that healthcare information systems are no longer isolated. They may be complex, integrated systems that extend beyond organizational boundaries. For example, sending patient discharge information from hospital to GPs. These healthcare information systems provide support not only for the administrative function of organizations but also for the direct care of patients (Bakker, 1998). Inappropriate clinical decisions and the subsequent serious consequences to patient care and patients themselves may occur if data is incorrect or not available due to a security compromise of the healthcare information system (Bakker 1998).

Damage from a breach of security in a paper-based system, although serious, is contained within a localized area. The damage is incidental compared with damage from a security breach from a complex, integrated inter-organisational IS, which can be colossal and systematic (Bakker, 1998). To minimize the risks of security breaches, stringent, explicit, and goal-directed security measures need to be implemented. This implementation of security measures needs to be balanced between the financial cost of security provision, and the security side effects that decrease the ease of use of the healthcare information system (Bakker, 1998). If GPs find an EHR system not secure enough they may not use it (GPB DHAC 2000 p180). Alternatively, if GPs find the

EHR system too difficult to use due to stringent security they may not endorse the uptake of such a system either (Cacek 1994, GPB DHAC 2000 p180).

There is much support for use of the Internet as a secure standardizing medium for distributing EHRs (Stein, 1997; Chadwick et al, 2000, Gritzalis and Lambrinoudakis 2004). For example, Stein (1997) submitts the security infrastructure used for financial transactions including digital signatures, cryptographic protocols, firewalls, strong authentication and hardened operating systems will be more than adequate to protect health information stored in databases and while it is transmitted over the internet.

In another example, in the UK, Chadwick et al (2000) presented a convincing argument for using the public Internet rather than the dedicated NHS private network (NHSnet) for accessing and transferring clinical patient records between secondary and primary care. Chadwick et al (2000) proposed using the Internet as an integrating network was as safe as, if not safer than NHSnet because the Internet utilised stronger security methods than those proposed at the time by NHSnet.

Specifically their system utilised a secure, encrypted internet connection to link hospital diabetes information system with GPs, in 35 districts in Britain. Confidentiality of patient data was ensured by encrypted passwords using public key encryption (PKI) and digital signature technology to ensure users were who they claimed to be. Such rigorous user authentication prevented hackers from masquerading as legitimate users. Firewalls were employed to maintain integrity of the hospital intranet and avoid unauthorised entry via the Internet while permitting authorised users to gain access. 128 bit, strong encryption was used for all patient data transmitted across the internet. This reduced any attempt to decrypt a message to an average of 5.4×10^{24} years. A web based interface to the hospital diabetes IS was developed for users replacing an inflexible paper-based system.

Chadwick et al (2000) believe such network integration of IS's could be generically applied to many other forms of chronic disease management apart from diabetes. This

would allow health service professionals to fully harness the benefits of improved availability of patient information without jeopardising patient confidentiality.

Chadwick et al (2000) gave a reassuring argument from a security aspect. However, more reassurance would have been created had hard data been presented to support their claim. It should also be noted the argument for this networked IS could have been written from a biased viewpoint. At the time the research was undertaken one the paper's six authors owned Westman Medical Software, Manchester, UK. This software was used to develop the diabetes IS and used as a base on which to build the Internet connection which accessed this system.

2.6 Conclusion

The literature review began with discussion on how the patient information flow within the Australian healthcare system has been impeded resulting in the need for EHRs. The review then progressed to discuss the technological solution of EHRs proposed to improve the information flow and the impact EHRs have on GPs' work practices during consultations.

More specifically, the literature reported patient information flow is inextricably linked to the structure of the healthcare system. Changing of emerging trends indicated how the healthcare system, particularly general practice, is changing as it adapts to the needs of modern age to become contemporary Australian general practice. Developments in clinical computerization of general practice in Australia and the UK were contrasted – the progress in the UK being more advanced due to early government and private sector financial support and the development of a standard coding system.

The literature reported the main negatives for EHRs were not technical issues such as lack of security because the same technical measures used to protect financial data can be used to protect health information. Support is given for use of the internet as a secure standardizing medium for EHRs. Nevertheless security is a widely reported

major issue regarding electronic transmission, storage and access to patient records and must be carefully managed. Rather the main negatives for EHRs are ethical, social and legal considerations such as the curious nature of humankind and information privacy.

Establishing patient authentication for EHRs with UPIs contained on a portable patient held device is a main cause of change in GPs' work practices during consultations. From a privacy aspect, patients may feel their information privacy is threatened when issued with a device containing a UPI which allows others to access and transmit their medical records. Thus access control needs to be carefully managed in order to maintain the integrity of patients' information privacy.

The IT era is altering the circumstance surrounding the patient - GP relationship, especially during consultations due to privacy implications from legislation with EHRs. The literature claims GPs' work practices will be more streamlined through the use of EHRs but this will require changes in GP work practices.

In conclusion, much published literature exists worldwide for CPRs, the predecessors to EHRs, but scant published literature on detailed impact of the more contemporary EHRs on general practitioners' work practices during consultations has been found. Of the studies published, Heard's and Grivel's et al's (2000) authoritative report was thoroughly researched and generally well referenced. Claims of streamlined work practices in Heard's and Grivel's et al's 2000 report did not give specific details of how these improvements to work practices occurred. Furthermore, at times it was unclear if the idea presented was supported by the citation provided or if this citation supported a similar idea that was presented adjacent to it.

Emery et al's (1999) work focused on a CPR system rather than an EHR system. Leung et al's (2004) work was undertaken in a hypothetical situation. Health*Connect's* Program Office (2003, vol 3, part 3) evidence gave only preliminary findings after a two-month period, December-January, from the commencement of the Health*Connect* Tasmanian Trial. This limitation of findings was reported as follows:

> "Due to the limited exposure of both the health care providers and consumers to Health*Connect* to date many of the detailed questions contained within the national research and evaluation framework cannot be answered definitively at this point in time".

Health*Connect* Program Office (2003)
Health*Connect* Interim Research Report Vol 3,
part 3, p2, Canberra, ACT, Dept of Health and Aging

Further results from the Health*Connect* trials have not yet been publicly released.

Therefore, the impact of EHRs on general practitioners' work practices is an under-researched area in medical/health informatics literature. Review of existing literature has exposed a gap in previous research involving the impact of EHRs in general practice. As identified above only a small number of studies have addressed the impact of EHRs in general practice. This deficiency of literature of EHRs is not surprising since the realisation of EHRs is relatively new, having evolved to the current level only in the last five or so years. Some published literature found on EHRs typically introduced EHRs from the viewpoint of a government perspective or/and did not provide research results or material worthy of being critically reviewed from an academic viewpoint (such as powerpoint presentations for briefing seminars) so was not included in the review.

3 Methodology

This methodology chapter explains how and why the current research was undertaken in order to meet the research aim, which was, as stated in Section 1.4.2, to assess the impact of IT, specifically EHRs on GPs' clinical work practices. The chapter begins with a detailed description and justification of the research design. It provides alternative designs/methods which were canvassed. It then elaborates details of the method utilized for investigating each research component. The chapter concludes with a brief explanation of the likelihood of bias in the research.

3.1 Description of Research Design

The research is composed of the following two components undertaken sequentially. Study one: an assessment of GPs' perceptions with accessing and exchanging clinical patient information. This study also recorded the GPs' current working environment and assessed GPs' attitudes towards using a pilot EHR system. Study two, was an observation of GP work practices whilst using the pilot EHR system.

3.1.1 Rationale for Two Research Components

The research was composed of two sequential components because it was necessary to firstly ascertain GPs' perceptions towards accessing and exchanging patient information. Study one, provided accurate information regarding GPs' willingness and technical capacity to use a pilot EHR system, which as such, may facilitate access and exchange of patient information. It also provided the researcher with background knowledge about GPs perceptions when they would later interact with the pilot EHR system. Understanding these perceptions would help to explain their behaviour towards changes in work practices associated with the introduction of the piloted EHR system. Only after the outcome of this perception study was established, could the second stage of the research be undertaken. If the GPs indicated an unwillingness and/or technical inability to use the pilot system, the second study could not and should not be performed.

3.1.2 Rationale for Selection of Quantitative and Qualitative Research Methodologies

A mixture of quantitative and qualitative research methodologies was applied to answer the research question. Leedy (1993, p 139) says if the nature of the data is principally verbal, then the methodology used should be qualitative. If the nature of the data is principally numerical, then the methodology used should be quantitative. Thus, "the nature of the data dictates the methodology" (Leedy 1993, p 139). The selected research methodology should be determined by the nature of the data required for the resolution of the research question, which in this research was, how are GP's clinical work practices impacted by the introduction of electronic health records.

The literature review helped the researcher to acquire a fundamental understanding of health professional's perceptions and experiences towards accessing and exchanging clinical patient information. Discussion with two senior GPs and other staff in IDGP helped to understand GPs' concerns regarding their clinical work practices surrounding accessing and exchanging patient information. This led to the construction of a quantitative questionnaire, consisting of 17 items, administered whilst interviewing GPs (study one). During each interview the author discussed issues regarding accessing and exchanging clinical patient information with GPs whilst strictly following the items in the questionnaire. The purpose of this GP interview was two fold. Firstly, to obtain as much in-depth, qualitative information as possible regarding GP's opinion about accessing and exchanging clinical patient information. According to Leedy's (1993) opinion, this approach was appropriate because the purpose was to draw the verbal perceptions from respondents. The second aim of this interview was to understand quantitatively the percentage of GPs within the available sample size holding certain perceptions on the research topic. So the quantitative questionnaire survey was conducted at the same time as the qualitative interviews. The advantages of conducting a questionnaire survey during interview are addressed later in the chapter under Section 3.2.1, 'Justification for Survey Approach".

A qualitative observational study (study two) was then applied for in-depth investigation of GPs' work practices whilst GPs used the pilot EHR in patient consultation. The data from the observational study once analyzed would contain visual and verbal data from videotaping so the methodology used was qualitative in nature. Furthermore the qualitative approach of the observational study meant the rationale behind it was not to generalize about results found to the larger population but to provide an illuminating detailed description of a specific group's phenomena.

Great difficulty was experienced in engaging GPs to participate in this observational study. This was partly because some GPs' pilot EHR systems were not fully functional at the time of the observational study. Also, as GPs are busy professionals, they felt it was difficult to commit time to the study. Finally, there were worries about intrusion of clinical practice and privacy.

The combined quantitative and qualitative approach used in study one provided the background knowledge for the research. Qualitative methodology was then applied to study two, the observational study, which sought in-depth understanding of GPs' work practices. The application of both quantitative and qualitative methodologies in a sequential manner for answering the research question used the concept of triangulation for data collection. Fig 3.1 below graphically shows the sequential use of quantitative and qualitative methodologies.

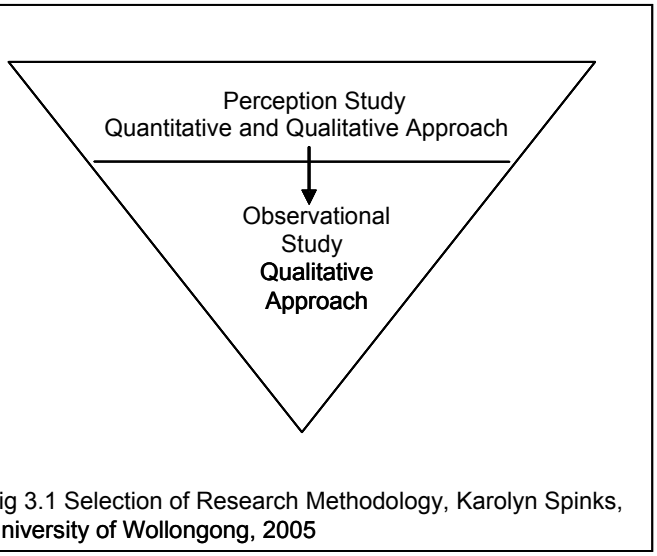


Fig 3.1 Selection of Research Methodology, Karolyn Spinks, University of Wollongong, 2005

The data from the perception study once analyzed was partly numerical in nature upon which statistical analysis was performed. Essentially the perception study resulted in descriptive quantitative statistics and additional qualitative statements regarding the accessing and exchanging of patient information and the pilot EHR system.

3.1.3 Canvass of Alternative Designs

Consideration of how to best address the research question through aligning the best methodological vehicle with the purpose of the research was undertaken. After contemplation of various methodologies including experimental research, action research and naturalistic inquiry, phenomenological study, an ethnographic study, a case study, the final research approach considered appropriate and practical for the undertaking was a perception study and an observational study. This canvassing of alternative designs helped to achieve rigor in the research design phase for the current research. The following paragraphs elaborate some of the strategies canvassed and discuss each ones' relevance for the overall research.

3.1.3.1 Case Study Strategy

Yin (1994, p9,10) states the case study is the preferred strategy when "a "how" or "why" question is being asked about a contemporary set of events over which the investigator has little or no control" and that bias must not be present. Although the current research question fulfills most of these criteria and a case study approach could have been used, too much bias was present for the case study strategy to be utilized. The bias was inherent in the constraints of the project since a convenience sample of GPs was used, rather than a preferred random sample. More detail on the presence of bias in the current research is provided at the end of this chapter. Furthermore, 12 GPs seemed inappropriately too many for examination within a single case study or multiple case studies. Lastly, good case studies are weakened if unsupported by previous theoretical proposals to guide data collection and analysis and they often also depend on triangulation data gathering (Yin 1994, p11, 13).

3.1.3.2 Experimental Research

Experimental research is often a form of quantitative research involving experiments with a high level of constraint upon which statistical analysis may be performed. Data collection and analysis is carefully defined and precisely followed. It may involve a pretest-posttest design or a control group. The control group may be used as a baseline upon which any change in the experimental group may be measured (Leedy 1993, p123). Experimental research was discarded from the current research design because the sample size of the study was too small and recruitment of a control group of GPs was not possible. Because of this, detailed statistical analysis was not achievable for the experimental research approach. Finally, Experimental Research seemed an unsuitable vehicle with which to answer the research question of investigating the impact of EHRs on GPs clinical work practices because it was impossible to undertake experiments.

3.1.3.3 Action Research

Action research can be defined as "the study of a social situation with a view to improving the quality of action within it" (Elliott 1991, p69 in Blaxter et al 1996, p 64). As the current research does not seek to improve efficiencies of GP clinical work practices, as stated in chapter one, section 1.4.3.2 "Limitations of the Research", action research was deemed unsuitable.

3.1.3.4 Naturalistic Inquiry

Graziano and Raulin (2004 p51) declare naturalistic inquiry as a flexible approach which involves observing subjects in their natural environment whilst not altering or limiting the subject's behaviour or environment. In naturalistic inquiry the research is not bound by hypotheses which dictate particular methods of observation – the researcher is at liberty to transfer attention to any behaviors which seem interesting. This methodology seemed inappropriate for the current research because requesting GPs to answer a questionnaire during interview was not their natural behaviour nor was observing them under video camera surveillance when they were using a newly

introduced IT system. Finally, naturalistic inquiry seemed an unbefitting approach with which to answer the research question of investigating the impact of EHRs on GPs clinical work practices because the GPs behaviour and environment was limited.

3.2 Method Details for Perception Study

3.2.1 Justification for Survey Approach

For the perception study to address the research objectives (stated in section 1.4.2), a survey of a convenient and purposive select group of GPs was undertaken. The survey method chosen was a structured interview using a questionnaire as an interview framework. The framework allowed the researcher some control over the topic under discussion. By using this approach advantages of interviews could be utilized. For example

> "the person being interviewed is encouraged to highlight self-perceived issues or relationships of importance. This can be of inestimable value in understanding contexts and creating links that are key aspects of research".
>
> (Gorman and Clayton, 1997, p45)

In addition, richer information could be obtained and the limitations of questionnaires such as respondent inability to elaborate answers were minimized (Thomas 2003, p 69). For example, the researcher encouraged the interviewees to elaborate on particular issues so that full explanations were recorded, compared with the brief answers initially offered.

The GPs were not familiar with the topic of unique patient identifiers (UPIs), therefore the personal touch afforded by an interview allowed the researcher to brief the interviewees on UPIs. This research method enabled the GPs to provide informed responses.

3.2.2 Selection of Participants

The study population for this part of the research was identified by the Illawarra Division of General Practice, Wollongong, NSW. This was a convenience sample of 14 GPs from IDGP's Diabetes Research program. The GPs in the Diabetes program,

although a small sample size, were considered to be suitable for two reasons. Firstly, they were a cohesive group of practitioners whose Diabetic patients present regularly. Secondly, they were all relatively comfortable with using computer technology. Thirdly, they were the users of the Smart ID Information System (pilot EHR system). Of these 14 general practitioners, 12 GPs (86%) agreed to participate in the research, the remaining two GPs declined, due to other commitments and interests.

These 14 GPs were initially addressed in a seminar, then, contacted via follow-up letter and phone call prior to interview. Each contact with the GP by the researcher emphasized the GPs valuable contribution in helping to answer the research question. Furthermore, to assess the impact of EHRs on GP work practices through the use of the Smart ID Information System, experienced general practitioners were studied. Written consent for interviewing was gained from each GP prior to the interview.

3.2.3 Design of the GP Interview Questionnaire

The aim of the GP interview questionnaire was two fold; firstly, to guide the direction of the interview; secondly, to obtain the relevant data required for answering the research question. The GP interview questionnaire was designed so that it could be used to provide a structured framework for the interview. With this in mind, factual type questions were set out at the front of the questionnaire. These questions were designed to elicit information regarding the type of computing environment in which the GP worked. Questions seeking GPs' opinions on more in-depth issues were positioned in the middle of the questionnaire. These questions were designed to obtain GPs' opinions on problems and issues associated with exchanging healthcare information, concepts associated with use of UPIs in general practice, who should have ownership of and access to patient information, the use of smart cards to store patient information, and the use of wireless/mobile information technology in general practice. The final question encouraged the GP to express any additional comments or concerns regarding the Smart ID Information System (Appendix E provides the questionnaire).

3.2.3.1 Justification for Choice of Questions: Content and Purpose

The questionnaire items were designed with the perception study's purpose in focus, which was, to assess GPs' perceptions with accessing and exchanging clinical patient information. It was critical to choose relevant questions and carefully plan the order of the questions. Only carefully considered questions relevant to this subject were chosen and superfluous questions were avoided. The idea for each question originated from initial discussions with senior GPs and IDGP staff. In the draft questionnaire there were originally forty questions but the number of questions was reduced in order to keep the length of the questionnaire (and interview) within a reasonable limit. Wording of the questions was also carefully considered so responses or answers given could be interpreted easily. Each question was critically assessed for its relevance to the research aim of assessing the impact of IT, specifically EHRs, on GPs' clinical work practices. This test of face value and content validity for each question was done by placing the potential answer to each question in context against the research question. If the answer to the question did not relate to the research question, it was removed. Questions 1-5 were asked to determine the existing IT environment in which the GP worked in order to identify how the GP currently accessed patient information. Questions 6-14 were directly relevant to the issue of exchanging and accessing patient information and how GPs perceived this. Questions 15-17 were directly relevant to types of possible technological devices GPs would use to exchange and access patient information. Table 3.1 lists each question and its purpose.

Table 3.1 Content and Purpose for Each Question in GP Interview Questionnaire

Question Number	Question Name	Question Purpose
Q 1	Computer-based Patient Records	To assess how GPs currently accessed patient information
Q 2	Identifying Patients and Accessing Patient Records	To assess how GPs currently accessed patient information
Q 3	Electronically Transferring Pathology Results	To assess how GPs currently accessed patient information
Q 4	Frequency of Use of Computer-based Patient Record System	To assess how GPs currently accessed patient information
Q 5	Connection to Internet/Intranet Services	To assess how GPs currently accessed patient information
Q 6	Information Flow When Exchanging Patient Information	To assess problems GPs perceived surrounding exchange and access of patient information
Q 7	Specific Information Flow Problems Experienced	To assess problems GPs perceived surrounding the exchange and access of patient information
Q 8	Types of Media for Sharing Information	To assess the type of media GPs considered useful fo accessing and exchanging patient information not only now but also in the future
Q 9	Patient Identification and GP Work Practices	To assess how GPs perceived access to a patients' EHR via a UPI would affect patient identification and GP work practices
Q 10	Ownership of Patient Information	To assess GPs' perceptions concerning who should have ownership of patient information
Q 11	Access To Patient Information	To assess GPs' perceptions concerning who should have access to patient information
Q 12	Issues of Electronic Exchange of Patient Records	To assess GPs' perceptions on the main issues concerning them with EHRs such as data integrity, security, patient identification, data ownership
Q 13	Data Fields Used When Transferring Patient Information	To assess GPs' perceptions regarding the type of data fields they find useful now compared to data fields they believe they would find useful in the future.
Q 14	Remote Access to Patient Records (Q14)	To assess the degree to which GPs perceived they would require access to patient records whilst outside their surgery
Q 15	Mobile Phones	To assess how many GPs carried a mobile phone for work purposes
Q 16	Remote Searching for Patient Records Using a Wireless Device	To assess GPs' perceptions towards using a mobile phone to access patient records whilst outside their surgery
Q 17	Preferences for Portable Electronic Device and Additional Comments Regarding the Smart ID Information System	To assess GPs' preferred choice of an electronic device to be used with the pilot EHR system (Smart ID IS) and any other concerns for the same they may have not yet discussed earlier

3.2.4 Piloting the GP Questionnaire and Interview

Prior to conducting the formal interviews with the selected GPs, the questionnaire was pilot tested with an independent GP who was not involved in the diabetes research program nor in the Smart ID Information System project. This GP agreed to participate in a practice interview with the aim of assessing the interview structure and questionnaire and of providing feedback to the researcher. Piloting the questionnaire and interview with a domain expert tested its validity and allowed adjustments to be made before undertaking the interview proper in the GP community.

3.2.5 Method of Data Collection

Prior to data collection, each GP was sent an information pack (provided in Appendix E) containing an introductory letter outlining the current research, consent form and copy of the questionnaire for pre-reading. Most of the data was collected by visiting each GP at their surgery premises. One interview was conducted at a GP's residence outside of surgery hours. The interviews were conducted with either individual GPs or with two GPs consisting of husband and wife teams who worked in the same surgery. The length of interviews ranged from 30 minutes to two hours depending on the level of GP familiarity and interest with the topic. The average interview was 45 minutes. IDGP subsequently reimbursed the GPs for their time. With the GP's permission, each interview was taped onto audiocassette to assist with transcription.

3.2.6 Ethics Approval

The research approach of a structured interview with questionnaire for the perception study was formally approved by the University of Wollongong's Ethics Committee. (Appendix C provides ethics approval letters.)

3.2.7 Quantitative and Qualitative Data Entry

Audio transcription was conducted to document the oral discussion into an accurate written record using MS Word. Collation of interview results also involved entering the data into a MS Excel spreadsheet where basic statistics and charts were generated.

3.2.8 Method of Analysis of Results

The quantitative analysis of GPs' answers from the multiple choice questions was represented as a series of histograms. The histograms were created by calculation of the percentage of GPs who favoured each response. They were then examined for existence of dominant trends in order that conclusions could be drawn.

The qualitative analysis of GPs' statements and in-depth explanations obtained during interviews involved description and representation of their views in a textual format. This description and representation of their views was integrated in the discussion and analysis section of the results chapter for the perception study.

3.3 Method Details for Observational Study

3.3.1 Justification for Observational Approach

3.3.1.1. Application of Visual Media as Qualitative Research Method

Peter Loizos, in the book 'Qualitative researching with text, image and sound' edited by Bauer and Gaskell (2000, p93), suggest that the use of continuous moving images taken by videotaping offers the attainment of a powerful accurate record of real-world, real-time actions and events. The visual form of the videotape is also supported with spoken words on the sound track of the videotape. Videotaping was subsequently applied to the current research as the primary investigative tool for the observational study. This was done with the intention of using aggregated results from the video footage rather than publishing images from the video footage. Strengths and weaknesses of videotaping are detailed in the next paragraph.

For the observational study to address the objectives of the research (stated in section 1.4.2) mediated observation through videotaping was used to unobtrusively examine GPs' work practices during consultations. It was considered most appropriate to undertake the observation in a natural live situation at the GPs' usual work place rather than in a simulated situation. This was considered to yield the most true and meaningful results.

Videotaping was undertaken only after both GP and patient written consent was secured. It was selected because it enabled the acquisition of the richest data possible for the circumstances: close-up, detailed observation of GPs working during consultations in their given environment. A second strength of videotaping is, it is non-disruptive and relatively unobtrusive compared to other means of data collection such as direct observation, questionnaires and interviews. Thirdly, it provided a contextual record of the work practice. Lastly, videotaping facilitated the collection of *real* GPs' work practice data in *real* time which could be reviewed repeatedly. A weakness of direct observation, of which videotaping may be considered a form of, is its reflexivity meaning the event may proceed differently because it is being observed (Yin 1994, p80).

3.3.2 Selection of Participants

Participants were within the group of 14 GPs from IDGPs' Diabetes Research program. Advice on selection of participant GPs from within the group was sought from IDGP on exactly which GPs to approach for videotaping. IDGP staff then approached the identified GPs. These GPs may have been present at the initial educational/recruitment seminar address made earlier by the researcher.

3.3.3 Identification of Work Practices Through Secondary Data

Secondary data from a report (Frean, 2001) (provided in Appendix G), on GP clinical workflow processes containing workflow diagrams was used to identify work practice areas suitable for the current research. Frean's (2001) development of workflow diagrams in the report was achieved through analysis of pre-existing and hypothetical GPs consultationary activities in conjunction with a GP from IDGP.

3.3.4 Method of Data Collection

Following the initial contact made by IDGP with the identified GPs, an information pack (provided in appendix F) containing an explanatory letter and consent form for videotaping was sent to the identified GP's surgery by the researcher. A similar

information pack (provided in appendix F) was also made available for the GPs' diabetic patients. This pack was forwarded to these patients by the GPs' administrative staff. Arrangements were then made between the GP and patient for an appointment. The researcher arrived prior to the appointment to set up the video recording equipment. The consultation was then overtly video taped without the presence of the researcher.

Two GPs each with two patients were examined during the GP-patient consultative period commencing with the GP calling the patient in from the waiting room to the consultation room and ending with the conclusion of the GP-patient consultation.

3.3.5 Ethics Approval

Formal ethics approval for videotaping of GP – patient consultations and publishing of aggregated results only (not video footage) for the observational study was sought and secured from University of Wollongong Human Ethics Committee. (Appendix C provides ethics approval letters.)

3.3.6 Qualitative Data Entry

Data entry of videotaped results involved systematic review of the video material. Results are presented in four separate tables, one for each consultation, with each one showing division of visual and verbal content.

3.3.7 Method of Analysis of Results

Analytic processing of the four consultations, involved firstly comparison of GPs' work practice flows (actions and conversations) between all consultations. These results were then aggregated and diagramised in a flow chart.

3.3.8 Follow-up Interviews From Secondary Data

It was decided the undertaking of follow-up interviews with the selected GPs after the consultations were video taped was unnecessary because similar interviews were previously conducted by a fellow researcher following evaluation of a trial of the Smart ID Information System. Results from the fellow researcher's interviews are discussed

in chapter five, research results, analysis and discussion of observational study. A copy of the researchers' interview questions, are included in Appendix H.

3.4 Likelihood of Bias

Sometimes in qualitative research bias may be caused or even deliberately sought because researching the characteristics of a phenomenon may be more interesting and/or more easily investigated at either end of the spectrum rather than use of average examples (Morse and Richards, 2002, p173). Bias may be defined as "any influence that may have disturbed the randomness by which the choice of a sample population has been selected" (Leedy, 1993, p213). The likelihood of bias is acknowledged in the current research due to the employment of convenience samplying with the chosen group of GPs in IDGP's Diabetes Research Group. Furthermore, because convenience sampling was used, caution has been taken not to over generalize the results of the research.

Despite deliberate use of convenience sampling, overt measures were taken to guard against further inappropriate bias. However, bias may have influenced the research design and results. Measures taken to avoid bias were professional objectiveness, rapport establishment with interviewees and asking of unbiased questions, and camera use to capture events during consultations rather than physical presence of the researcher.

3.5 Conclusion

This chapter has explained how and why the current research was conducted. It provided the research design and justified the same by presenting the rationale for selecting the research methods used for each component of the study. These methods were selected so that the research obtained optimal results and achieved the research aim of assessing the impact of IT, specifically EHRs on GPs' clinical work practices. A canvass of alternative designs/methods was included in the chapter. In summary, the current research is essentially a mixture of quantitative investigation and qualitative inquiry with two approaches used - structured interviews and observation. In the

following two chapters results obtained from each of the two components are presented, analysed and discussed.

4 Research Results, Analysis and Discussion of Perception Study

This chapter presents the results of the GP interviews graphically as histograms to facilitate interpretation. Following the histograms the results are analysed and discussed in detail. The total mark for some questions is more than 100% because the respondents were encouraged to tick as many boxes as they felt necessary. Qualitative information gleaned from interviews, but which could not be presented graphically is embedded in the text for each question.

As stated in the introductory chapter, originally the Smart ID Information System project team considered the implementation of a smart card instead of a USB I-Key. Therefore, some of the GP interview questions in this chapter have referred to smartcards and not I-Keys. The concept between the two is exactly the same in terms that they both provided a secure means to access patient records, so the results are not considered to be affected. The project research team also considered a portable electronic device such as a WAP enabled mobile phone or personal digital assistant (PDA) to enable GPs to remotely access patient records. The project's chief investigators decided to limit the scope of the Smart ID Information System project, therefore a WAP enabled mobile phone and PDA were not implemented in the project.

4.1 Presentation of Results from Perception Study

4.1.1 Computer-based Patient Records (Q1)

The GPs were asked if they used computer-based patient records, and if so to identify the clinical software program and/or the practice management software program their practice was using.

Figure 4.1 below shows twelve respondents (100%) use Medical Director as their clinical software program. Versions of Medical Director used range from v1-v2.6. Five respondents (42%) used Pracsoft, an appointment and billing package as their practice management software. Pracsoft is used on a trial basis only. Twelve respondents (100%) used a manual appointment system. No respondents (0%) used MIMS clinical software.

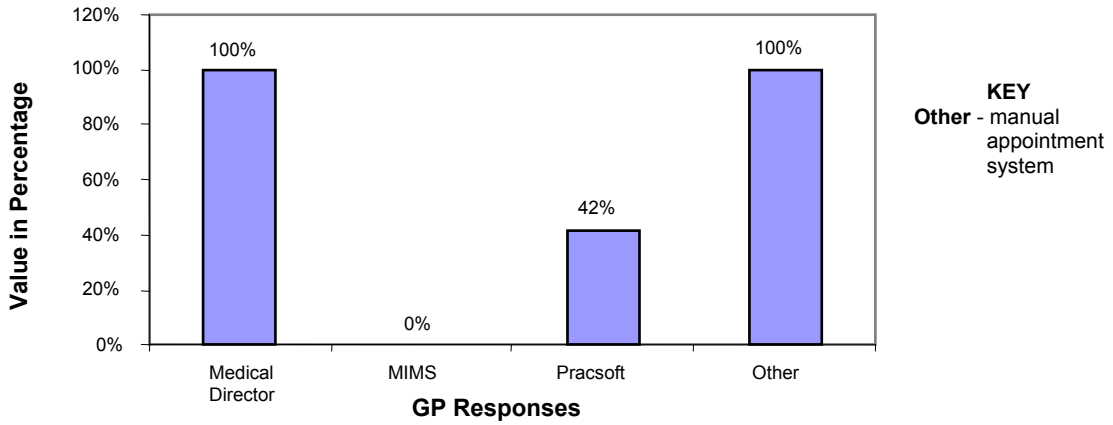


Fig 4.1 Distribution of Clinical & Practice Management Software

4.1.2 Identifying Patients and Accessing Patient Records (Q2)

The GPs were shown a list of options for accessing a patient's record. They were asked to indicate how they, or their practice staff currently identified the patient and which information they used to find the patient's record in the surgery filing system.

Figure 4.2 below illustrates twelve respondents (100%) used the patient's name as the main method of accessing a patient record. This field is used both when a patient's record was accessed via Medical Director and when a patient's paper-based file was accessed. In addition to using the patient's name, nine respondents (75%) also used the patient's file number (which is generated by the surgery), and one respondent (8%) also used the patient's address in addition to the patient's name. No respondents (0%) used the patient's medicare number nor other information to access surgery records.

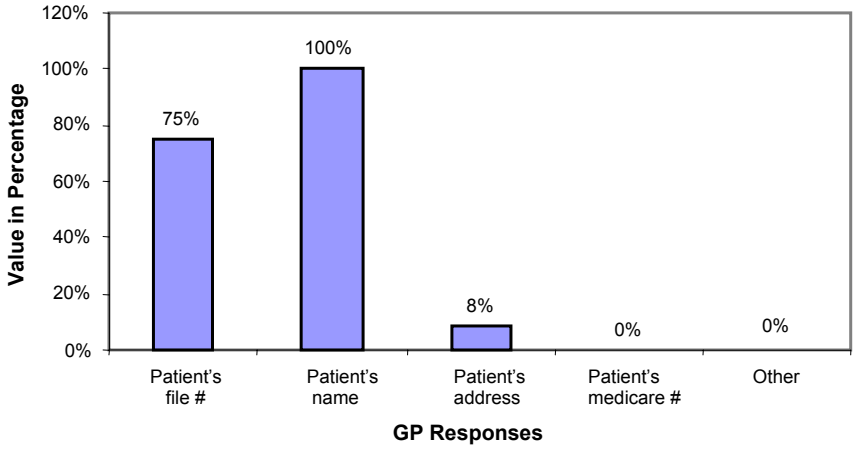


Fig 4.2 Type of Information Used to Access Patient Records

4.1.3 Electronically Transferring Pathology Results (Q3)

The GPs were asked if they or their practice staff, electronically transferred patient results from their pathology company to their practice, and if so how often they do this.

As illustrated in figure 4.3 below, ten respondents (83%) transferred patient results electronically from their pathology company to their practice on a daily basis. The remaining two respondents (17%) transferred patient results electronically from their pathology company to their practice on a weekly basis.

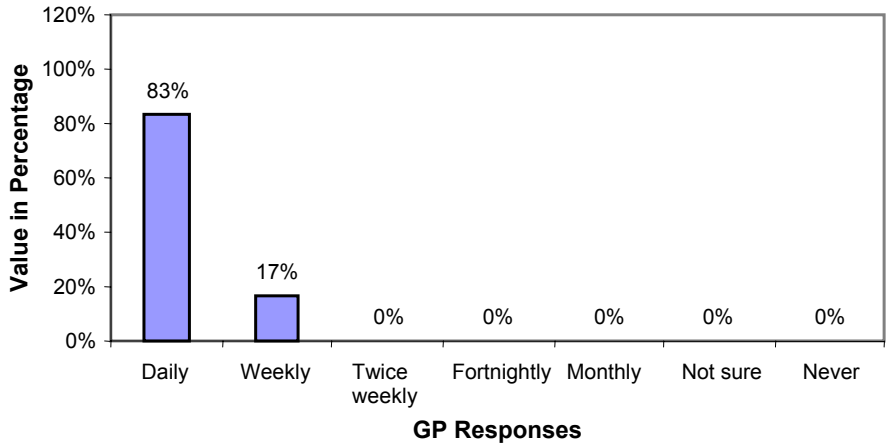


Fig 4.3 Frequency of Electronic Transfer of Pathology Results

4.1.4 Frequency of Use of Computer-based Patient Record System (Q4)

The GPs were asked how often they used a computer based patient record system, Medical Director, at their practice. Figure 4.4 below indicates twelve respondents (100%) used Medical Director software everyday.

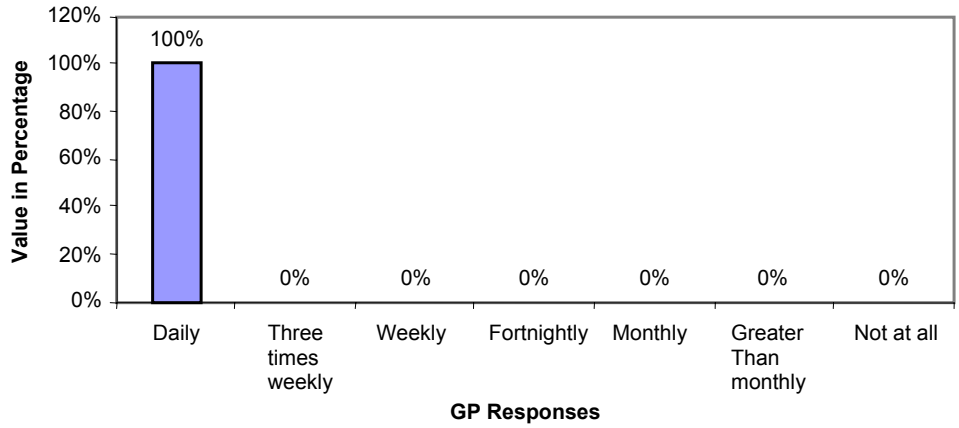


Fig 4.4 Frequency of Use of Computer-Based Patient Record System

4.1.5 Connection to Internet/Intranet Services (Q5)

The GPs were asked about the Internet and Intranet connection from their surgery. Figure 4.5 below indicates six respondents (50%) currently connected or intended to connect to IDGP's intranet from their surgery. An equal number of six respondents (50%) connected or intended to connect to *both* IDGP's intranet *and* the Internet from their surgery.

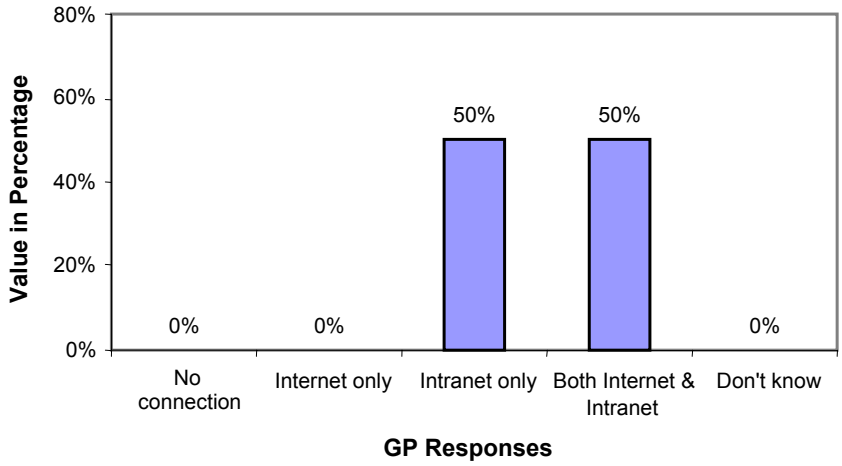


Fig 4.5 Connection to Internet / Intranet

4.1.6 Information Flow When Exchanging Patient Information (Q6)

The GPs were asked if they perceived a problem with information flow when exchanging patient information existed at their surgery. Figure 4.6 below illustrates eleven respondents (92%) believed there was an information flow problem when exchanging patient information. One respondent (8%) did not believe there was a problem with exchanging patient information.

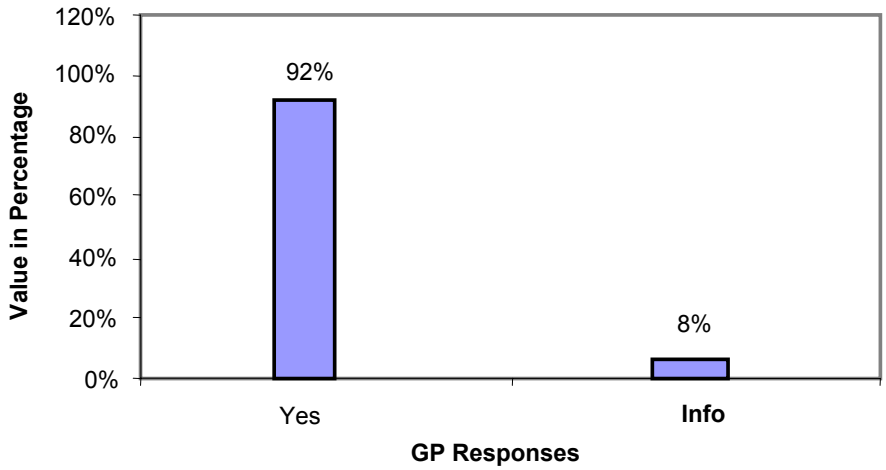


Fig 4.6 Existence of a Problem When Exchanging Patient

information included:
Specific problems identified by GPs when exchanging patient

1. obtaining information from the local hospital in relation to pathology results, details of patients' care whilst in hospital, and discharge details;
2. obtaining results from private pathology companies when their patient went to another doctor and the patient does not request copy of the results be forwarded to their regular doctor, for example, upon visiting a medical center outside of regular doctor's surgery hours. This resulted in duplication of tests and patient files;
3. obtaining correct information from patients when seen by other doctors;
4. delay in getting information such as previous medical records, from other doctors;
5. illegible handwriting.

4.1.7 Specific Information Flow Problems Experienced (Q7)

The GPs were given a list of options where they were asked to identify specific problems that they experienced with the current system of exchanging information.

Figure 4.7 below illustrates the results. All twelve respondents (100%) indicated they were unable to view relevant previous medical episodes. Four respondents (33%) thought the current system was error prone. Three respondents (25%) experienced other problems with missing files. Three respondents (25%) experienced a mixture of other problems including illegible handwriting, patients being unable to remember health events in detail, patients being unable to give details of other health service providers. Two respondents (17%) experienced difficulties with identifying patients.

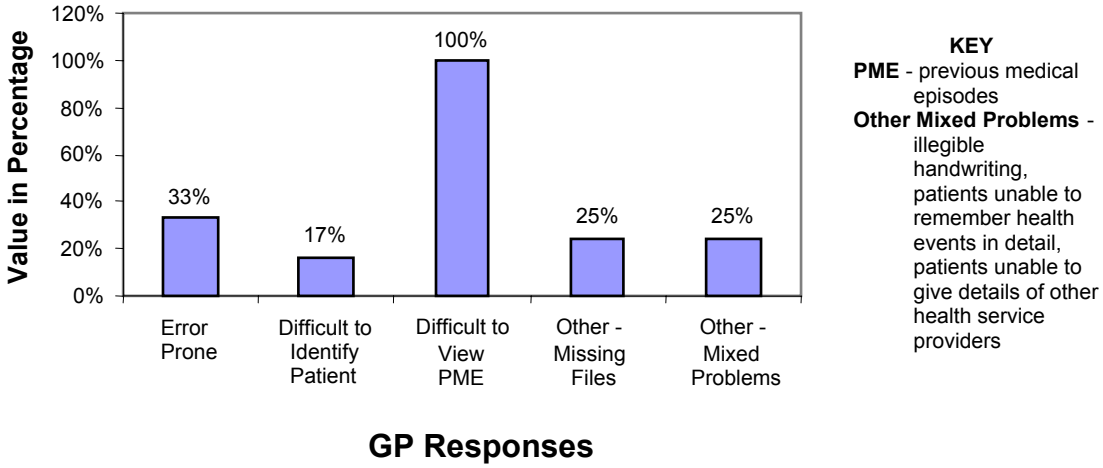


Fig 4.7 Specific Problems Experienced When Exchanging Patient Information

4.1.8 Types of Media for Sharing Information (Q8)

The GPs were asked which types of media they thought were currently useful for sharing patient information in their practice. Also, which types of media they thought would be useful in the future. Results have been presented as two separate figures: figure 4.8a) for current media and figure 4.8b) for future media.

Figure 4.8a) shows ten respondents (83%) believe personal communication is a useful way of sharing patient information. Twelve respondents (100%) indicated they believed media including phone, fax and letter are currently useful for sharing patient information. Ten respondents (83%) believe email is a currently useful media for exchanging patient information. Four respondents (33%) believe Internet is currently useful for exchanging patient information. No respondents (0%) believe smart cards are currently useful. Two respondents (17%) believe mobile technology is currently useful for exchanging patient information. No respondents (0%) believe there are other kinds of currently useful media for exchanging patient information.

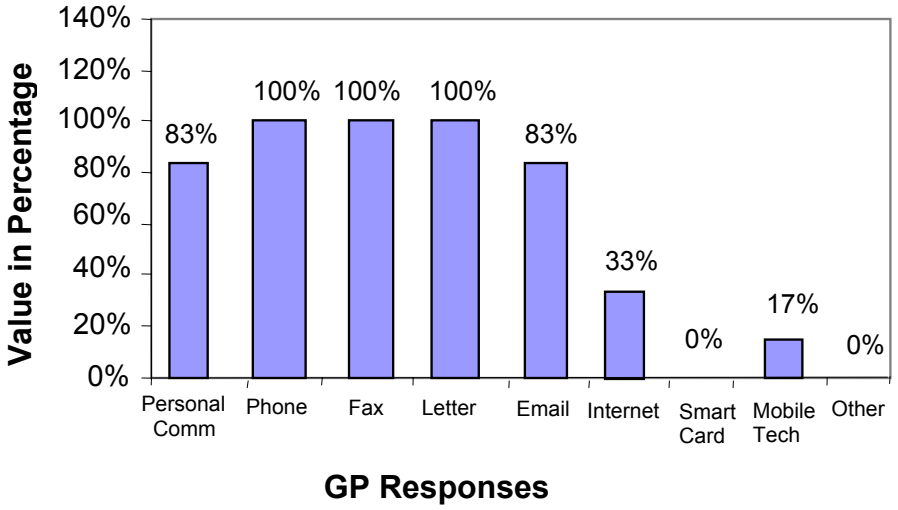


Fig 4.8a) Current Media Considered Useful For Sharing Patient Information

Figure 4.8b) shows 10 respondents (83%) believe personal communication will be a useful way of sharing information in the future. Eleven respondents (92%) believe phone, fax and letter will be useful in the future for sharing patient information. Twelve respondents (100%) believe email will be useful in the future. Twelve respondents (100%) believe the Internet will be a useful future media for exchanging patient information. Ten respondents (83%) believe smart cards will be useful in the future for exchanging patient information. Eleven respondents (92%) believe mobile technology will be a useful medium in the future. Two respondents (17%) believe other kinds of media including laptops and subcutaneous chip implants will become useful future media for exchange of patient information.

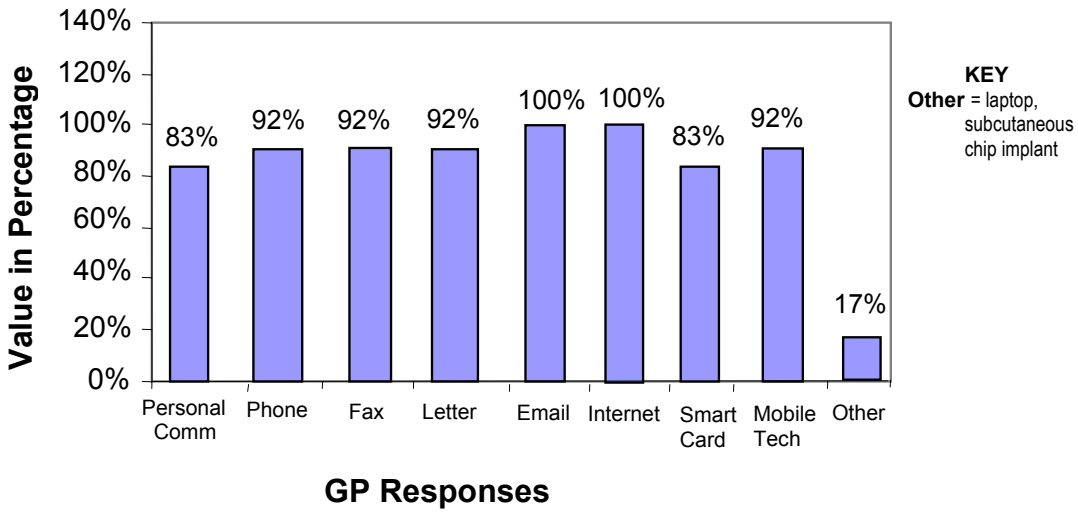


Fig 4.8b) Future Media Considered Useful For Sharing Patient Information

4.1.9 Patient Identification and GP Work Practices (Q9)

GPs were given a list of seven options relating to UPIs and asked to identify which problems and/or benefits they percieved a UPI used to identify patients and provide subsequent access to the patients' EHRs would have on work practices. The list of options were:

- information management;
- efficiency of patient care;
- access to patient records;
- exchange of patient information;
- difficulty of use;
- procedural change with current patient identification and record access;
- reliability.

Figure 4.9 illustrates eleven respondents (92%) indicated 'Yes', they thought a UPI would improve management of patient information, whilst one respondent (8%) was 'Unsure'. Eight respondents (67%) indicated 'Yes', they thought a UPI would help provide more efficient patient care, one respondent (8%) indicated 'No', it would not, three respondents (25%) indicated they were 'Unsure' if it would. Eight respondents (67%) indicated 'Yes', they thought a UPI would provide an accurate and confidential means of accessing patients' records although, four respondents (33%) were 'Unsure' whether a UPI would allow this. Twelve respondents (100%) indicated 'Yes', a UPI would improve exchange of patient information between health service providers. Two respondents (17%) indicated 'Yes', a UPI would be too difficult to use, six respondents (50%) indicated 'No', a UPI would not be too difficult to use, and four respondents (33%) were 'Unsure'. Two respondents (17%) indicated 'Yes', a UPI would change current procedure of patient identification and record access, (58%) seven respondents indicated 'No', it would not change procedures and two respondents (17%) were 'Unsure' whether it would change current procedure of patient identification and record access. One remaining respondent omitted to provide an answer for this part of question nine. Eleven respondents (92%) indicated 'No', a UPI would not be a less reliable way of accessing patient records compared to the current method, whilst one respondent (8%) was 'Unsure' if it would be less reliable.

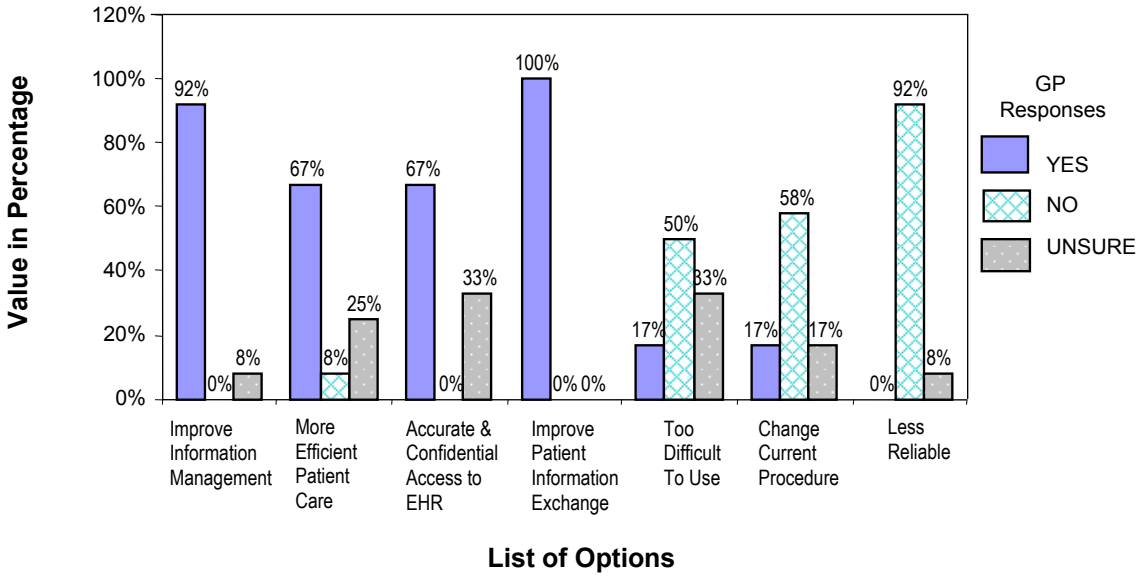


Fig 4.9 Perceived Problems / Benefits of UPIs

Notes :

- 'Change current procedure with patient identification and record access' option - one GP omitted answering this option in question nine. However, as this omission was from only one respondent, it does not adversely change the results for this part of question nine.
- Also, one GP mentioned the UPI would alter the patient's confidentiality status between GP and patient.

4.1.10 Ownership of Patient Information (Q10)

The GPs were asked who they thought should own patient information stored in a smart card or portable electronic device, such as a mobile phone or PDA. They were asked to select their preferences from five different options and encouraged to select as many options as they thought appropriate.

Figure 4.10 below indicates eleven respondents (92%) believe the patient's primary GP should have ownership of patient information stored in the portable device. Six respondents (50%) believe the patient should have ownership of their own information. Three respondents (25%) believe patient's secondary GPs (other GPs) should have ownership. One respondent (8%) indicated they believed government departments should have ownership of the patient information stored in the portable device. Four respondents (33%) believe other health service providers should have ownership of the patient information.

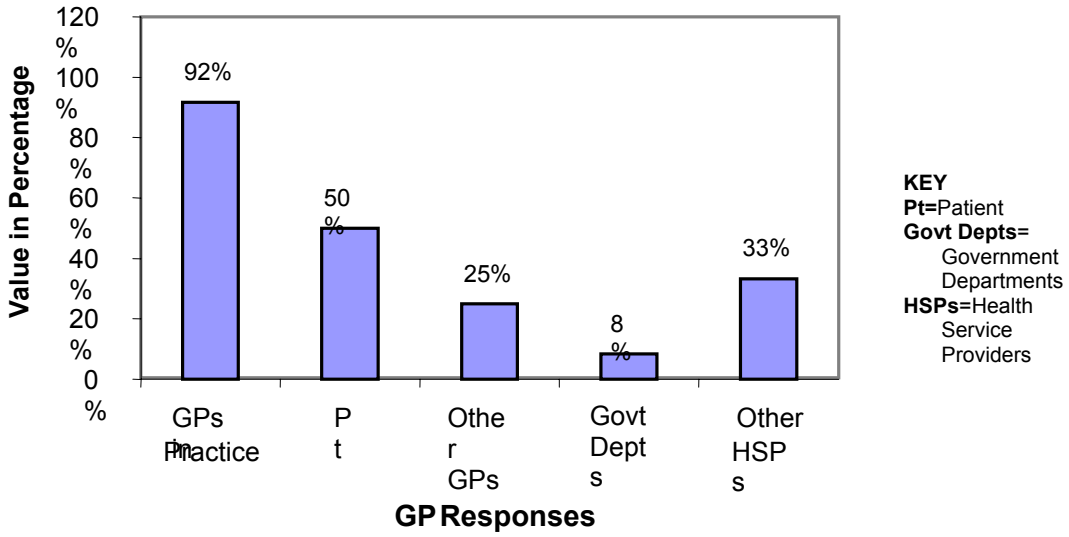


Fig 4.10 Distribution of Ownership of Patient Information

4.1.11 Access To Patient Information (Q11)

The GPs were asked who they thought should have access to patient information stored in a smart card or portable electronic device. They were asked to select their preferences from eight different options and encouraged to select as many options as they thought appropriate. The question included two assumptions. Firstly, that the patient had given consent for their information to be accessed. Secondly, that the information requested was in the interest of patient care and confidentiality.

Figure 4.11 below illustrates all twelve respondents (100%) indicated they believed the patient's primary GP should have access to the patient information stored in the portable device. Ten respondents (83%) believed the patient should have access. Twelve respondents (100%) believed the patient's secondary GPs should have access to the information. Four respondents (33%) believed police should have access to the patient information stored in the portable device. Two respondents (17%) believed government departments should have access to the patient information. All twelve respondents (100%) indicated they thought other health service providers and ambulance officers respectively should have access to the patient information stored in the portable device. One respondent (8%) believed pharmacists should have access to the patient information.

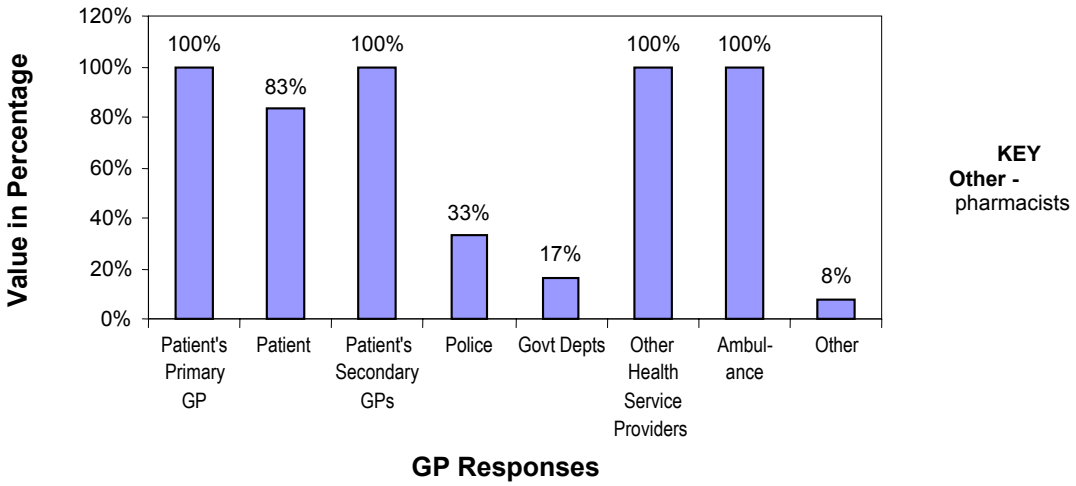


Fig 4.11 Access to Patient Information Stored In Portable Device

4.1.12 Issues of Electronic Exchange of Patient Records (Q12)

The GPs were asked if they were given the opportunity to exchange patient records electronically with other health service providers, which issues from the following list would be of concern to them: data integrity, data security, data ownership, patient identification, no concerns, or other concerns. They were encouraged to select as many options from the list as they thought appropriate.

Figure 4.12 below shows six respondents (50%) indicated data integrity would be a concern for them when electronically exchanging patient records. Ten respondents (83%) demonstrated data security would be a concern. Six respondents (50%) demonstrated data ownership as a concern. Five respondents (42%) showed they would be concerned about patient identification when electronically exchanging patient records. One respondent (8%) indicated he had no issues of concern. Finally no respondents (0%) indicated any other issues of concern.

The GP who indicated he had no issues of concern explained he trusted the system would be secure.

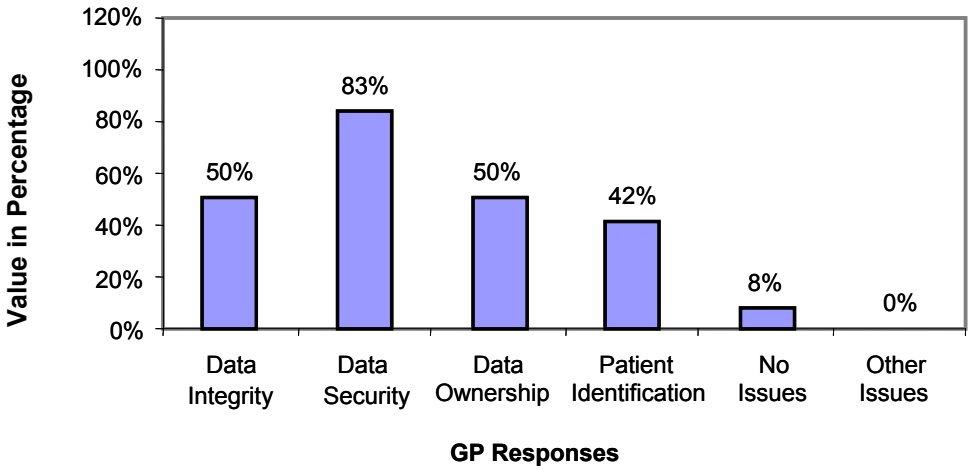


Fig 4.12 Issues of Electronic Exchange of Patient Records

4.1.13 Data Fields Used When Transferring Patient Information (Q13)

The GPs were shown a list of 23 data fields which may be transferred between GPs and other health service providers when exchanging patient information. This question referred to all kinds of transfer of information between GPs and various health service providers, for example, pathology forms, patient referrals. They were asked to indicate which data fields they currently used and also which data fields they would like to use in the future. Results have been presented as two separate figures: figure 4.13a) (Current) and figure 4.13b) (Future).

Figure 4.13a) shows all twelve respondents (100%) currently use the following data fields when exchanging patient information:

- patient's surname
- patient's given names
- patient's postal address
- patient's phone number
- patient's gender
- patient's date of birth
- referring GP's name
- referring GP's provider number
- tests requested
- request date

Three respondents (25%) currently include the following fields:

- patient's record number (from the GPs surgery)
- patient's hospital medical record number (MRN)

Eight respondents (67%) currently use the patient's Medicare number. Nine respondents (75%) currently use the following fields when exchanging patient information:

- patient's clinical notes
- patient's current medication
- patient's medical history
- patient's allergies

Six respondents (50%) currently used the referring GP's email address whilst eleven respondents (92%) currently use the referring GP's fax number. Ten respondents (83%) currently include the field of previous abnormal test results. Seven respondents (58%) currently include the patient's immunisation history. Eight respondents (67%) currently include a data field for patient's lifestyle factors. No respondents (0%) currently include any other data fields when exchanging patient information.

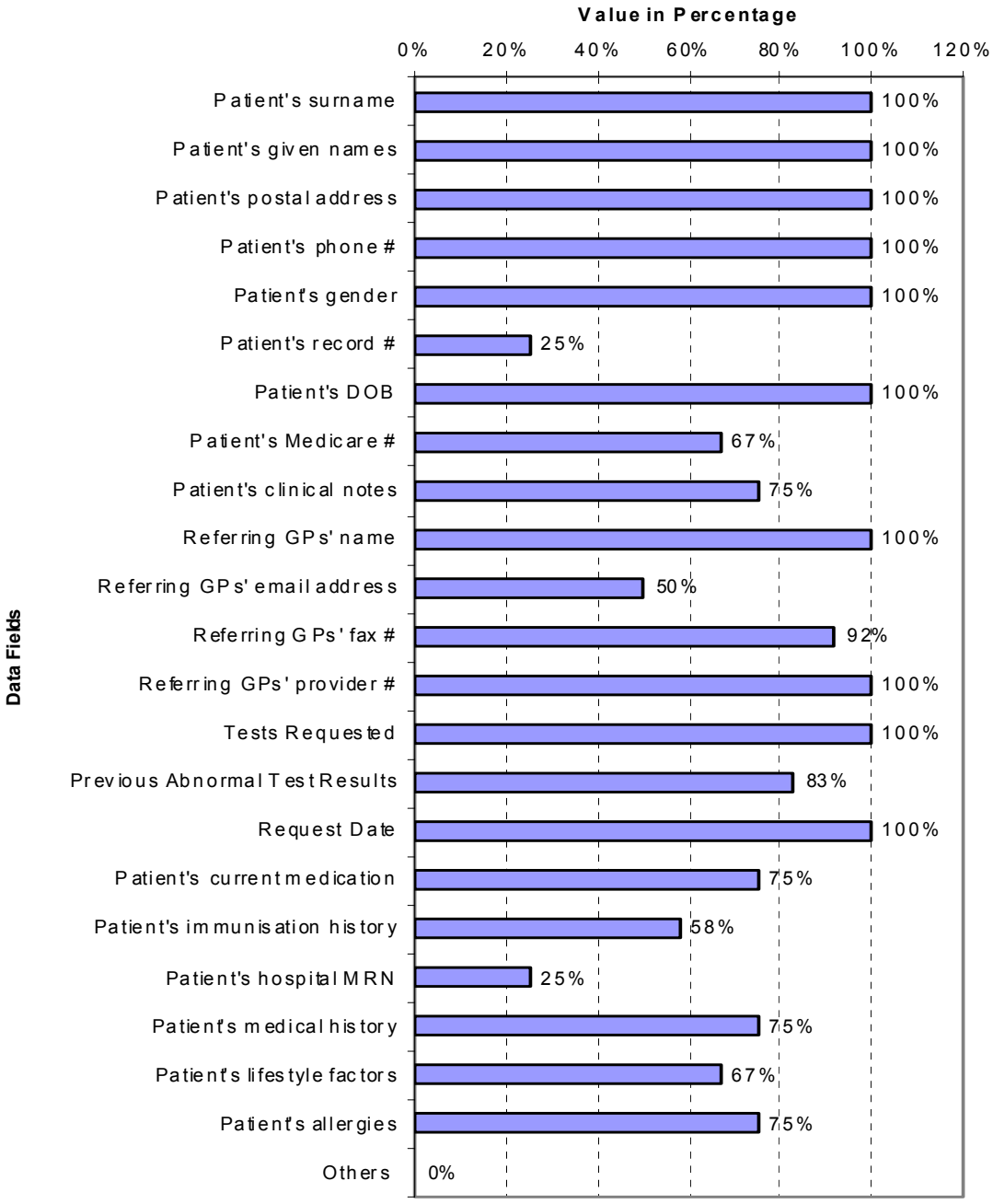


Fig 4.13a) Data Fields Used in Transfer of Patient Information Current

Figure 4.13b) shows all twelve respondents (100%) in the future would like to use the following data fields when exchanging patient information:

- patient's surname
- patient's given names
- patient's postal address
- patient's phone number
- patient's gender
- patient's date of birth
- referring GP's name
- referring GP's provider number
- tests requested
- previous abnormal test results
- request date
- patient's current medication

Six respondents (50%) indicated in the future they would like to include the patient's record number (from the GP's surgery). Ten respondents (83%) would like to include the following data fields:

- patient's Medicare number
- patient's clinical notes
- referring GP's email address
- patient's immunisation history
- patient's lifestyle factors

Eleven respondents (92%) would like to use the following fields when exchanging patient information in the future:

- referring GP's fax number
- patient's medical history
- patient's allergies

Eight respondents (67%) would like to use the patient's hospital medical record number (MRN). Seven respondents (58%) indicated they would like to include other data fields such as previous procedures eg angiograms, date of previous normal tests eg. mammograms and next-of-kin when exchanging patient information.

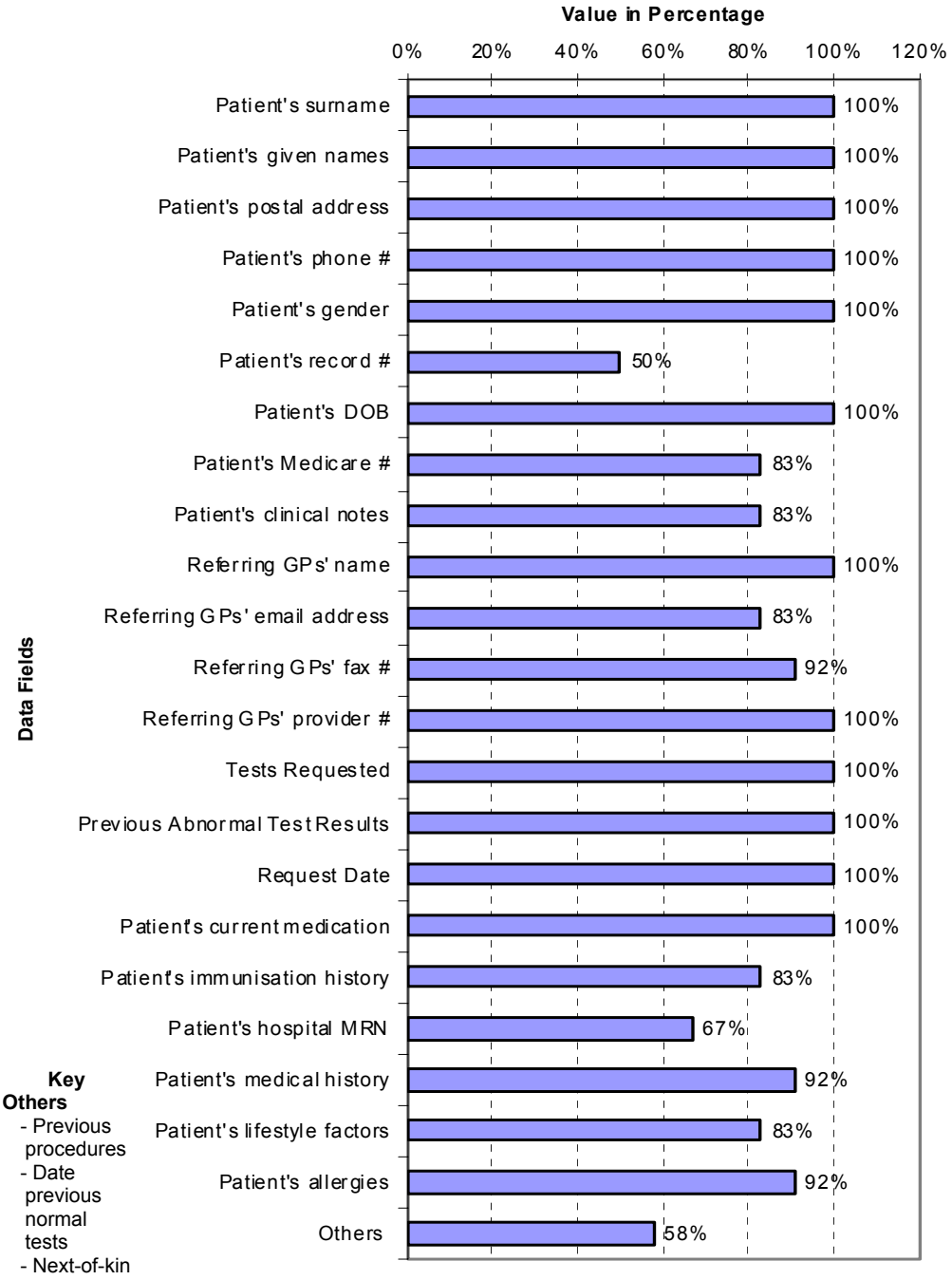


Fig 4.13b) Data Fields Used in Transfer of Patient Information Future

4.1.14 Remote Access to Patient Records (Q14)

The GPs were asked would they require access to their patient records from outside their surgery, for example, from a patients' home during a house call, whilst at patient meetings, whilst on the road or from their home.

Figure 4.14 indicates no respondents (0%) would ever require remote access to their patient records. Ten respondents (83%) indicated they would occasionally require remote access. Two respondents (17%) indicated they would often require remote access to their patient records from outside their surgery.

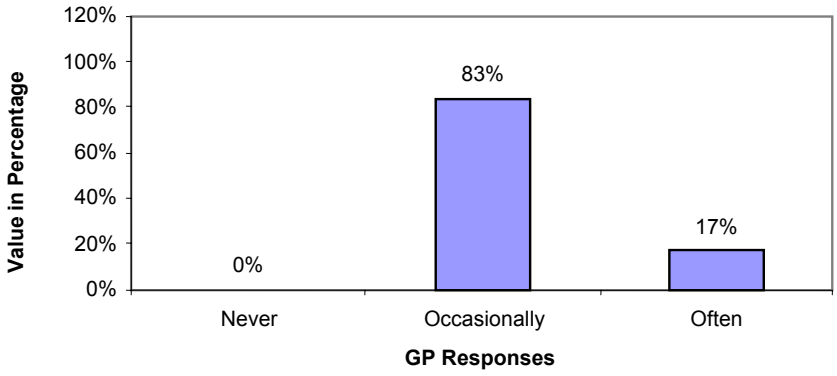


Fig 4.14 Remote Access Requirements to Patient Records

4.1.15 Mobile Phones (Q15)

The GPs were asked if they carried a mobile phone for work purposes. If so could they use the phone to connect to the Internet?

The results in figure 4.15 below show nine respondents (75%) carry a mobile phone but cannot use the phone to connect to the Internet. One respondent (8%) indicated they carried a mobile phone that does connect to the Internet. Two respondents (17%) indicated they did not carry a mobile phone for work purposes.

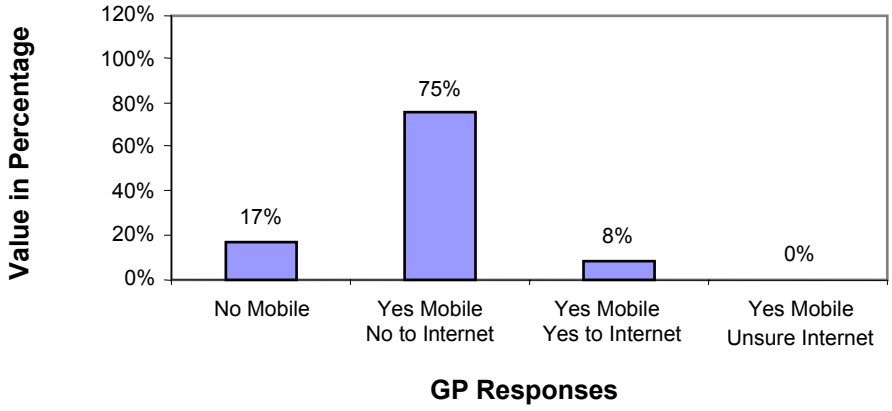


Fig 4.15 Use of Mobile Phones

4.1.16 Remote Searching for Patient Records Using a Wireless Device (Q16)

The GPs were asked their opinion of using a wireless technique, such as a mobile phone or PDA, to remotely search for patient records stored at the surgery or stored at another health service provider's office.

Figure 4.16 below indicates three respondents (25%) thought the idea of wireless remote searching for patient records was a very good idea. Six respondents (50%) believed it could be a good idea. Three respondents (25%) were unsure about the idea of using a wireless device to remotely search for patients' records. No respondents (0%) indicated they disliked the concept.

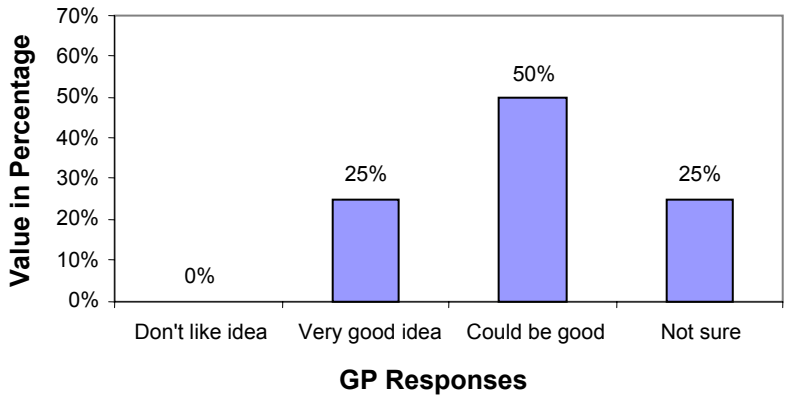


Fig 4.16 Perceived Use of a Wireless Technique to Search for Patient Records

4.1.17 Preferences for Portable Electronic Device and Additional Comments Regarding the Smart ID Information System (Q17)

GPs were asked if they had additional comments or concerns regarding the use of the Smart ID Information System, using UPIs in conjunction with a portable electronic device, such as a smart card, mobile phone, or PDA to access patient records. The GPs were also encouraged to indicate the type of portable electronic device that they would prefer. Results for the second part of question 17 are illustrated in figure 17 below. Results for GPs additional comments are listed on the following page.

Figure 4.17 shows eight respondents (67%) would prefer a smart card for use with the Smart ID Information System. No respondents (0%) wanted to use only a mobile phone or PDA. Four respondents (33%) indicated they would prefer to use both a smart card *and* a mobile phone or PDA with the Smart ID Information System.

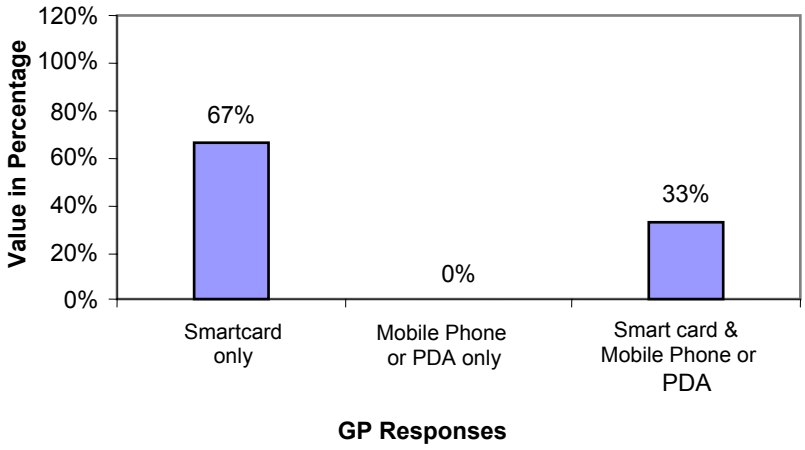


Fig 4.17 Preferences for Portable Electronic Device

GPs Additional Comments Regarding the Smart ID Information System

1. GP is eager to access patient files remotely to avoid necessity of removing paper-based files from surgery.
2. GP is in favor of smart card because it is easier to use and less complex than PDA. Although GP is also keen to access patient files remotely.

3. GP is enthusiastic about something small and compact like a smart card. Does not wish to have a mobile phone.
4. GP is indifferent towards technology in general – believes technology is not currently reliable enough. GP believes mobile phones can be expensive, dropped or lost. Sometimes GP is asked for habitual medications by patients who conceal or change their identity. A system to counteract this and positively identify people would be useful.
5. GP prefers the idea of smart card to access relevant previous medical episodes held by other health service providers. Also the ability to access patient files remotely is a good idea. If smart card system was portable this would be ideal.
6. GP is prepared to go along with whatever system and device is offered.
7. GP is in favor of smart card device over mobile device. Not everyone wants a mobile device. Patients may accept a smart card better because a smart card is similar to Medicare card system.
8. GP can't see a need for any system. However if must choose, GP would prefer to use a smart card device. This is because a smart card is less complicated, less expensive and more reliable than a mobile device.
9. GP believes anything is better than the current system of not being able to access patient information. The Smart ID Information System looks easy and convenient. GPs need a simple device so a smart card would be the best device at this stage. GP feels a subcutaneous chip implant is the technology of the future because it provides a means to uniquely identify the patient, stores information, cannot be lost, and only needs a minor procedure to insert it.
10. GP wishes to remove human error whilst maintaining the personal touch of medical practice. Smart ID Information System could prove to be more efficient but must also allow individual approach. GP prefers smart card device because it is simple and mobile devices can be lost or dropped. They may also be damaging to ones health.
11. GP believes the Smart ID Information System needs to be used first to determine its usefulness. GP specifies system would work best with smart card device in conjunction with mobile device.

12. GP is comfortable following whatever is decided because GP feels unfamiliar with the technology, although would feel *more* comfortable with a smart card system. GP's main concern is confidentiality.

4.2 Analysis and Discussion of Results from Perception Study

4.2.1 CPRs and Pathology Results

Results of the study identified all GPs used a CPR and they used it on a daily basis. All GPs interviewed had a network connection at their practice and they transferred pathology results electronically. Most of the GPs (83%) did this on a daily basis. The use of CPRs by GPs may be a reflection of improved clinical patient management software, proof GPs attitudes towards IT are changing and that they are becoming more comfortable in using it. In 1994 Cacek found GPs considered CPR systems at the time cumbersome and needed modifications before they would willingly use them. Cacek (1994) also found evidence supporting his hypothesis Australian GPs had a 'technophobia' when dealing with computers.

4.2.2 Identifying Patients and Accessing Patient Records

The study also identified that the most common field by which GPs and GP's practice staff identified patients and accessed the patient's paper-based records and CPRs was the patient's name. The patient's file number in conjunction with patient's name was the second most common field used. This file number was only relevant within the surgery. One GP used three fields: name, address and file number for identification and to access patient records. The literature states (NSW MACPHI 2000, Health*Connect* Program Office 2003, vol 3, part 3, p68) that with EHRs a UPI is needed to authenticate a patient and access a patient's record. Furthermore, that GPs will need to routinely obtain a patient's consent to access that patient's EHR. Thus, the results obtained indicate the need for a change in GPs work practices to accommodate this consent and access procedure during consultations.

4.2.3 Information Flow

The literature identified (Appavu 1997, 1999, Bakker, 1998) that with current hospital-based systems there were information flow problems when exchanging patient information with health service providers. GPs were asked if they believed this to be true in General Practice. Most GPs interviewed believed there was an information flow problem when exchanging patient information between health service providers and the reasons for this were varied (Spinks et al, 2001; Spinks and Cooper, 2001). The most prominent issue faced by all practitioners was that they were unable to easily view information from previous medical episodes held by other providers including information from hospital visits (Spinks et al, 2001; Spinks and Cooper, 2001). Thus these results confirm information flow problems identified by the literature (Appavu, 1997, 1999; Bakker, 1998; Davidson and Holtz, 1998). The literature also suggests (Appavu, 1997; Davidson and Holtz, 1998) the UPI component of EHRs may be able to solve some of the problems GPs face with exchanging healthcare information between health service providers, since UPIs facilitate the secure linkage of electronic health records and allow for improved continuity of patient care.

4.2.4 Increased Use of IT

The results show most GPs believe that the future use of conventional media such as phone, fax, letter and personal communication for sharing patient information will remain fairly static with its current use. In addition, most GPs believe recently emerged electronic technology including email, Internet, smart cards and mobile technology will become useful in the future for sharing patient information. A few GPs believe other electronic tools such as laptops and subcutaneous chip implants will become useful in the future for sharing patient information. The trend identified towards the increased use of electronic technology in general practice such as email, internet, mobile technology, laptops and subcutaneous chip implants is a reflection of the increased use of IT in society in general. Whilst such electronic technology has been heavily used in other fields for a number of years, for example, the banking industry, its uptake in the medical field of general practice has been slow. This trend is

also a reflection of the changing attitudes of GPs in the acceptance of use of IT in their workplace.

4.2.5 UPIs

When exchanging patient information via EHRs it is important that patients are correctly identified with UPIs. GPs responded to seven options relating to UPIs asking them which problems and/or benefits they thought a UPI would have for their work practices. Results of the study indicated most GPs interviewed perceived the UPI component of EHRs do have the potential to benefit general practice in terms of improving information management and the exchange of patient information between health service providers (Spinks and Cooper, 2001). Many GPs believe the UPI component would allow reliable, accurate and confidential access to patient records and help provide more efficient patient care. However, GPs had mixed feelings about whether the UPI would be too difficult to use, and also whether it would change their work practices in terms of identifying patients and accessing records.

4.2.6 Ownership of Patient Information

The wide spread of the results relating to patient information ownership illustrate the GPs interviewed have mixed feelings about patient information ownership. Nearly all GPs were against government departments having ownership of the patient information (Spinks et al, 2001). Likewise, many GPs were against other health service providers including the patients other GPs having ownership. Most GPs interviewed believed the GP who wrote the information should own that information although fifty percent of GPs were comfortable with the patient being included in ownership of the patient information.

During the interview one GP explained he believed patient information should not be owned by any one party in particular. He believed anyone should own the patient information provided it is in the interest of the patient's care and confidentiality, and provided the patient gives consent and the recipient applies discretion when using the patient information. The GP explained one would need to withhold information to

stop another person taking ownership of it and using it. However, withholding information in this way is often contrary to the best interests of the patient and is impractical in the health field. The GP used the following example to clarify his view:

> "A specialist rings a GP regarding a patient's blood sugar level prior to an operation. That GP cannot say, "No I'm not giving you that information. I own it and the patient owns it, and I'm not giving it to you."
>
> GP respondent during interview

The issue of data ownership is one that has to date, attracted very little attention in the literature according to the Health*Connect* Program Office (2003, vol 2, report 6, p 27). The GPs' views on patient information ownership belonging to the GP who wrote the information are likely to have been influenced by the landmark court case (Breen v Williams) wherein the High Court ruled medical records were the property of the doctor who had written them (ALR 1996 in Health*Connect* Program Office, 2003, vol 2, report 6, p 27). Current literature has highlighted unclear guidelines of data ownership with respect to EHRs (Health*Connect* Program Office, 2003, vol 2, report 6, p 27). This is because EHRs cross health service provider boundaries where they have the potential to be authored by several individuals and organizations including non-medical practitioners. Each of these individuals and organizations could claim ownership over their own entries. The above Health*Connect* literature states application of the principles from the Breen v Williams case to EHRs would result in an impracticable position possibly requiring consent of each author before the information could be used by another contributor (Health*Connect* Program Office, 2003, vol 2, report 6, p 27). Finally, it has been suggested the term information ownership refers to a traditional idea of a document and that custodianship may be a more applicable term with the sharing of data in the electronic age (Health*Connect* Program Office, 2003, vol 2, report 6, p 27).

4.2.7 Access to Patient Information

Another important issue identified in the literature was access to patient information because if mismanaged it can threaten patient's privacy and threaten the doctor-patient

relationship (Appavu, 1997, 1999; American Psychiatric Association (APA), 1999, Leung et al (2004), Stein 1997, NSW MACPHI 2000). The wide spread of the results relating to patient information access indicated GPs' strong support for other health related entities having access to patient information (Spinks and Cooper 2001; Spinks et al 2001). GPs also strongly supported the idea of patients having access to their own information. Other than patients, GPs were keen for other parties to have access to patient information but these parties were limited to the health area. They were: other GPs, ambulance officers and other general health service providers. Most GPs were against police, pharmacists and government departments having access to patient information, however, some GPs indicated during the interview if police had access to patient information, it may be helpful in crisis situations particularly for mentally ill patients. Although only one GP thought pharmacists should have access to patient information, it was indicated by this GP that pharmacists should be a major party entitled to patient information access due to the extensive range of non-prescription medications available that can interact with prescription medications.

GPs' caution to limit access of patient information to health service providers and away from non health service providers shows their concerns for maintaining a therapeutic doctor-patient relationship and is a reflection of concerns raised in the literature regarding privacy by Appavu (1997, 1999), APA (1999), Leung et al (2004), Stein (1997) and NSW MACPHI (2000). The introduction of new legislation which explicitly defines rules regarding access to patient EHRs as discussed in the literature review will likely be welcomed by GPs (RACGP 2002, Bennett 2001 p415/6, HealthConnect Program Office 2004 p57).

4.2.8 Issues for Electronic Exchange of Patient Records

The four most important concerns GPs have when electronically exchanging patient files were, in order of importance:

1. security
2. data integrity; data ownership
3. patient identification

GPs concern for security agrees with that reported widely in the literature as a major concern in EHRs (Bakker 1998, Barber, 1998, Gritzalis and Lambrinoudakis, 2004). Also identified in the literature (Robinson 1994 in Hovenga et al 1996) is the concept security and privacy in health IS are inextricably linked to each other. The mismanagement of security places patient health information at risk of being inaccurate, misused or disclosed without authorization. Thus patients' information privacy may be jeopardized. The literature reported by Davidson (2004), Woodhead (2002) in Cornwall (2002 p4), Bennett (2001), explained new legislative measures taken such as the NSW HRIP Act 2002, National Health Privacy Code, and NSW Health Information Privacy Code of Practice, which will all greatly reduce GPs' and patients' concerns for information privacy invasion and security mismanagement.

4.2.9 Data Fields Used When Transferring Patient Information

The results for data fields used when transferring patient information showed no data fields decreased for future use when compared with data fields currently used by GPs. Instead, results showed in the future GPs were keen to increase the amount of patient information exchanged. This is evidenced by GPs future desire to increase use of the following fields when transferring patient information whilst maintaining use of other fields currently used:

- patient's record number (only if a UPI)
- patient's medicare number
- patient's clinical notes
- referring GPs' email address
- previous abnormal test results
- patient's current medications
- patient's immunization history
- patient's hospital MRN (only if a UPI)
- patient's medical history
- patient's lifestyle factors
- patient's allergies
- other fields including previous procedures eg. angiogram, date of previous normal test eg mammogram, next-of-kin

Other fields GPs currently used included:

- patient's surname
- patient's given names
- referring GP's name
- referring GP's fax number

- patient's postal address
- patient's phone number
- patient's gender
- patient's DOB
- referring GP's provider number
- tests required
- request date

GPs' desire to increase the amount of patient information exchanged is another indication of their need for more patient information. Lack of patient information and poor information flow is a problem well recognized in the literature (NHIMAC 1999, NEHRT 2000, GPB DHAC 2000) and one which is able to be improved with ICT via way of EHRs.

4.2.10 Wireless Remote Access to Patient Records

Most GPs indicated they had a need to occasionally access their patient records remotely eg during a house call, or during nursing home visits (Spinks et al, 2001). The concept of using a wireless technique to remotely search for patient records was received positively albeit with some reservation by GPs (25% of GPs were not sure about the idea of remotely accessing patient records using a wireless device). No practitioners interviewed indicated they disliked the idea of wireless remote searching for patient records. Most GPs interviewed carried a mobile phone for work purposes but of these only one GP carried one that could connect to the internet.

These results of wirelessly and remotely accessing patient records support the notion that GPs are becoming more prepared to embrace the use of IT in their workplace because their attitudes are not strongly negative towards it. The results indicate GPs may be reservedly accepting IT which is different to the very negative attitudes GPs held towards IT in 1994 indicated by Cacek (1994).

4.2.11 General Opinion Towards the Pilot EHR System: Smart ID Information System

Most GPs conveyed they wanted to have a better system for accessing patient information than what was currently available to them but they stressed the system must be simple to use. Most GPs indicated they would prefer a Smart ID Information

System which utilised a smart card as this was easy to use (Spinks et al, 2001). A few GPs indicated their preference for a system with a smart card in conjunction with a PDA or a mobile phone.

4.3 Conclusion

The three specific research objectives for the perception study defined in chapter one, section 1.4.2 were:

1. to determine if GPs perceive the existence of a problem with the exchange of patient information between GPs and other health service providers
2. to understand issues/problems facing GPs in the implementation of EHRs via a micro project in general practice: Smart ID Information System
3. to ascertain GPs' perceived benefits/risks of using a pilot EHR: Smart ID Information System, using UPIs in conjunction with a portable electronic device, to access patient records and exchange healthcare information between health service providers

The study has succeeded in addressing the three objectives. The research has addressed issues and problems facing GPs with the way patient information is currently exchanged between GPs and health service providers. It has highlighted the needs/issues and problems of the selected group of GPs in relation to implementation of EHRs via the Smart ID Information System. Furthermore, the research has elaborated the benefits and risks to GPs of using a pilot EHR, Smart ID information System.

The results of the perception study showed GPs agreed there was a problem with the exchange of patient information and the information flow between health service providers (Spinks et al, 2001). They were generally willing to use IT to improve their work efficiency. They believed IT could help provide a solution to poor exchange of patient information (Spinks and Cooper, 2001). They were keen to increase the amount of information exchanged. Overall the idea of the Smart ID Information System as a pilot EHR system was well received by the GPs interviewed. The GPs stressed the system needed to be simple to use.

Evidence from the literature that the concepts and technologies used in such a system could benefit private practice was drawn on. However, the question remains whether GPs will be comfortable with the impact the smart ID Information system, and similar EHRs, is likely to have on GPs' day to day work practices during consultations. Answers to this question will be presented in the following chapter.

5 Research Results, Analysis and Discussion of Observation Study

This chapter presents the results of the observation study where GPs' work practices during routine consultations were observed whilst GPs used and did not use a pilot EHR system: Smart ID Information System. The observation study builds on results from the previous chapter where GPs' perceptions towards IT were assessed. Retrospective review of videotaped results are presented firstly in table format, then in a summarized flow chart. The results are then analysed using comparative analysis with the aim of comparing operational work practices and reporting the impact of the use of EHRs on work practices. The results are discussed in detail in relation to existing literature. The system interface was not part of the assessment.

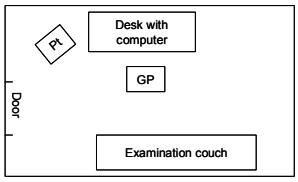
5.1 Presentation of Results from Observation Study

5.1.1 Tabular Results of Consultations

Intentional presentation of detailed tabular results of the consultations is included in the body of this chapter for the following reasons:

1. to communicate the essence of the overall flow of each consultation;
2. to show precisely how GPs work during consultations including nuances and complexities of the same;
3. to communicate the autonomous nature of GPs work practices whereby several things happen simultaneously. For example GP interacting with patient whilst reading from patient's notes and interacting with computer;
4. to highlight the individual nature of consultations.

5.1.1.1 Table 5.1: Consultation 1 - GP 1, Patient 1, with use of Smart ID Information System

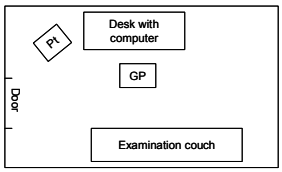
Visual	Verbal
GP's office of consultation GP x 1 enters office and stands near door holding pt's paper-based notes Pt x1 enters office and sits in chair adjacent to desk GP closes the door, sits in his chair and unfolds pt's notes	GP: come in [pt's name]! Thanks for coming Pt: That's alright
	
Pt shows GP a sore place on hand. GP exams it.	Pt: The swelling's gone down a bit GP: Yep! You're using a little bit of antibiotics? Pt: Oh yes, yes, its going well GP: Right. You want to see how your diabetes has been? Pt: Yes please
Pt gets I-key out of pocket and hands I-key to GP who puts it on desk GP inserts his own I-key into USB port on end of extension cord on desk Both GP and pt watch the computer screen	GP: got your little key there? Pt: Yes, there's mine GP: Lets plug it in
GP starts reading pt's paper-based notes Pt indicates size of calcium tablet he takes to GP Both GP and pt continue to watch the computer screen GP nods his head from side to side while waiting for computer to work GP continues to intermittently read pt's paper-based notes and gets extra stationary out of desk draw	GP: It's pulled up your file Pt: Oh well half way there. [pause] I've started taking the calcium caltrate 600 milligrams GP: Just one a day is it? Pt: Ahh, no, one a meal GP: Three times a day? Pt: Three times a day. They're enormous tablets – like that GP: Huge things. [pause] Modern technology!! Pt: Yeah! I went to see the dietitian and she's given me all the details on things. All my favourite vegetables are gone and my favourite fruits are gone (laugh) GP: It's a shame Pt: Yeah. (laugh) Oh it's not really a problem. So I'm just going to have to amend my diet now
Both GP and pt continue to watch screen GP removes his I-key from the USB port and inserts	Pt: There you go. GP: There we go now. So we look at your results. See how its been going Pt: HbA1c hasn't been too bad

Visual	Verbal
pt's I-key into same USB port	GP: A remarkable improvement
	Pt: On what it was, yeah!
	GP: From ten down to six point five. Also says you're due for another blood test
	Pt: Well I'm having HbA1c on Monday?
	GP: On Monday?
	Pt: Yes that's right. That's part of [inaudible]
	GP: That's at the hospital?
	Pt: Yes, it's near the cancer care unit
Pt turns away to get documentation out of his bag and hands it to GP	GP: Do you know if they're doing cholestrol as well? We only did that in August though. We don't need that it this stage. HbA1c which we need (reading from documentation handed to him by pt) Cholestrol done 11th August.
GP reads it then hands document back to pt	Pt: It's a non-fasting one as far as I know
GP indicates to pt information on computer screen who reads it	GP: But as you said your HDLs gone from point 8 to point 83.
	Pt: That's not too bad
	GP: No problems there! But it hasn't got above one yet.
Pt turns away and puts documentation back into bag	Pt: No, but it's getting there, it's getting there. I'm trying to do the right thing. It takes a little while
	GP: Certainly improvements in the total cholestrol
GP turns monitor to face toward pt better and indicates total cholesterol value on screen	Pt: Yeah, four and a half! Its well under
	GP: This is triglycerides. If we can get that down a little bit?
	Pt: Yeah but that's what worries me! I trim my fat off my meat and things. But I'm not going to be eating as much meat now so [trails off]
Both GP and pt continue to watch screen	GP: How's the blood pressure?
	Pt: That's come down quite nicely. That's sitting for the last four!
	GP: 120 over 70
	Pt: Which is reasonable
	GP: That's good, that's good. Body mass index?
	Pt: Well [inaudible]
	GP: Back up into the red. Put on another kilo
	Pt: I find it difficult
	GP: Going from 95 to 85 is reasonably good work
	Pt: Oh yeah! I was much more that 95 when I first started. I was 120
	GP: Oh well that looks prity good all up … starts January 2001 and goes across
Both GP and pt continue to watch screen	Pt: It's almost flat isn't it? But it's below the line. It's coming down slightly
GP motions with hand indicating a horizontal level	GP: That one we want to go up though (laugh)
	Pt: Oh is it. Is that the one we want to go up?
	GP: but yeah, its been very [inaudible]
	Pt: It's close to where it should be. Where as the HDLs [inaudible]. So anything else? That looks good!
	GP: It is good
	Pt: Yeah
	GP: [inaudible] … above the line

Visual	Verbal
	Pt: Yeah well with this new diet things may change a great deal
	GP: Total cholesterol going from above the standard to below the standard. Just got to keep it down. It's been very stable over the last six months
	Pt: Yeah well I'll keep taking the tablets. Like God said to Moses keep taking my tablets (laugh)
Pt picks up I-key off desk and hooks it on trouser belt GP records BP in pt's paper-based notes	
Both GP and pt simultaneously rise from their chairs and walk over to weighing scales [out of camera view]	GP: I'll get you to stand on my scales while you're here too. Pt: Yep GP: 86.
Both GP and pt simultaneously return to their seats Pt indicates to his neck	Pt: That's exactly the same as I was before. I feel a bit fatter because this jowls coming so I've got to lose it. My waist has certainly settled down
GP turns computer monitor back again then types at keyboard	GP: I'll just add your blood pressure on here in the Medical Director side of things
	GP: And you actually saw a dietitian didn't you?
GP reads information on computer screen and continues to enter information into computer via keyboard GP writes information into pt's paper-based notes Pt shakes his head GP listens to pt	Pt: Yes, I saw a dietitian yesterday. Uhmm, its quite amazing some of the stuff that has high potassium which I never thought of - peanut butter GP: Peanut butter Pt: Peanut better which is good for diabetics has got very high potassium. It's in the high range. So I'm only allowed one teaspoonful of that a day. Uhmm, all my favourite vegetables like cauliflower and broccoli – no! They're high in potassium. And the problem is they don't put potassium on the labels. GP: Not yet Pt: No
Pt nods head in agreement	GP: So you have to remember everything?
Both GP and pt look at computer screen	Pt: Yes, I have to refer to the sheets everytime. I don't have to double boil the potatoes but boil them for at least 20 minutes. Cut into small portions, boil 20 minutes, throw the water away. If I have any canned fruit I've got to get rid of all the liquid and have the canned fruit by itself. Frozen vegetables are better for you than fresh vegetables GP: Less potassium? Pt: Less potassium. All vegetables should be boiled not steamed, or roasted, or microwaved GP: Leeches out more potassium Pt: Still that's the way they work it. Uhmm, if I didn't have the dietary advice I don't know whether I would, uhmm, be able to do what I'm going to have to do

Visual	Verbal
	GP: Yeah Pt: Well, that's pretty good actually. I'm quite happy with the results
GP folds pt's paper-based notes into B5 size and leaves on desk Both GP and pt simultaneously stand up and walk toward door. GP opens door for pt. Pt exits GP exits leaving pt's paper-based notes on desk	GP: Mmmm (in agreement) Pt: And I'll see you again GP: Yes and I'll have those blood tests. Every six months for diabetes Pt: Yep. Uhmm and they do it just about every fortnight at the moment GP: Ok! Pt: Ok! Screen saver on computer screen activates.

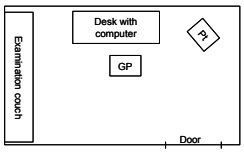
5.1.1.2 Table 5.2: Consultation 2 - GP 1, Patient 2, without use of Smart ID Information System

Visual	Verbal
GP's office of consultation Office door is open	GP: Come in [pt's name]. Have a seat.
Pt x 1 enters office and sits in chair adjacent to desk placing an envelope on edge of desk GP x 1 enters office bringing pt's paper-based notes with him, closes the door and sits in his chair at desk  	GP: We've got you here to check your diabetes. So how are you today? Pt: Alright GP: Alright Pt: yeah GP: We'll have a check up at your diabetes to see how all things regards that are going. Are you having you problems? Pt: My back problems not doing it any good I think GP: Ok
GP reads pt's paper-based notes GP gets additional stationary out of desk draw GP writes comments in pt's paper-based notes Both GP and pt watch changing pictures of screen saver on computer screen	Pt: I didn't have a good night last night. Blood sugar went through the roof. 13.8. That's the highest it's been for a long time. Six o'clock this morning, I got out of bed into my chair it was nine. I mucked around for a little while - didn't do much - and before breakfast, a couple of hours later, it was 7.3. I had breakfast which was just two weetbix and two hours later 7.5. So they're the sort of readings I've been getting. But that 13.8!! Cos I'm not feeling real good [trails off] GP: That back pain, it's slowing you down isn't it? Pt: I can't do nothing. GP: From someone who had excellent control to someone who is struggling now. When do you see the specialist again? Pt: 11th, Monday. Thursday due back from holiday GP: What did you have for tea last night? Do you think there

Visual	Verbal
Pt shakes head	was any food there that you ate? More than usual? Third helping of desert?
GP writes comments into pt's paper-based notes GP types at keyboard bringing up pt's CPR in Medical Director	Pt: No. I had two short loin chops grilled, bit of cucumbery sort of stuff, broccoli, uhmm, steamed, carrots, cauliflower, slice of toast and a serving of ice cream which I normally have every night which is low fat
	GP: [inaudible] extremely low fat
Pt watches computer screen	Pt: Yeah, well the dietitian's all for below 10. This is boardering on the 10 for sugar and for fat seven
	GP: Nothing different to usual?
	Pt: No, no. I was in so much pain last night
	GP: Yeah
	Pt: Is that normal? When you're in a fair bit of pain that your levels can go up.
	GP: It certainly can. It can seem to influence it. Some people find that stress influences it. Also lack of activity that goes with it. Your bodies just [trails off]
	Pt: I was just scratching around. I don't know whether I'm doing too much. I don't think this works as far as … [inaudible]
GP puts stethoscope into his ears and puts sphygmomanometer cuff on pt's left arm, taking pt's BP then removes cuff from pt's arm and stethoscope from his ears. GP records BP in pt's paper-based notes GP motions with his hand indicating	GP: I'll check your blood pressure
	Pt: Mmmm
	GP: 130 over 70 so its still well controlled
	Pt: When have you got to worry about blood pressure?
	GP: We aim for 130 and below 90. So if you're below those two you are considered normal. With diabetics we try to aim lower than that if we can. The 70 is excellent. It was 155 over 85 in September. It usually makes it easier to control the sugars too but I think the pain is having a large influence at the moment
GP rises from chair and walks over to scales (out of camera view)	GP: I'll get you to stand on the scales too, to see how much of that weight you've lost
Pt also rises from chair and walks over to scales Both GP and pt return to their seats	GP: 89. 92 you were last time. That's makes a big difference
	Pt: Ok I believe I'm losing weight but I don't believe my diet's changed. Instead of three slices of bread for lunch I'll have two.
GP records pt's weight in pt's paper-based notes	GP: Every little bit helps. Probably want to do another injection in your back and go from there. Get some longer term relief next time
	Pt: [inaudible] injection [inaudible] myself because I couldn't believe no pain. NO pain!! Nothing. I went down the steps a couple of times and I don't know whether I should have been doing that. I can't believe this. I feel like a teenager
	GP: A big improvement
GP turns computer monitor toward pt better and	GP: I mean you've consistently lost weight! You've gone from 98 back in 99 to 89. You dropped it, came up a bit, then

Visual	Verbal
indicates pt's weight on screen Pt reads information on screen GP turns computer monitor back again Pt continues to watch screen saver pictures on screen GP writes information in pt's paper-based notes GP writes comments in pt's paper-based notes GP nods head in agreement Pt stands up GP stands up and concludes the consultation	came back down Pt: When I was diagnosed a diabetic, whenever it was, I was 106. What's that 16, 17, yeah 17 kilos GP: the sad thing is your diabetes control. Last time you did the test is was 8.5. All due to the back pain so we have to look at that. As you said your diet's got to be good if you're loosing weight Pt: Yeah well I run off the rails from time to time but not very often GP: and your blood pressure's improving, cholestrol was excellent too last time down to four Pt: The chap I go to – a chiropractor suggested some anti-inflammatories – he said they are the natural type and shouldn't upset my stomach. They say one three times a day. But I'm taking three at a time, three times a day GP: So nine altogether Pt: Everybody's horrified when I tell them. Is nine too many? GP: You could probably try and reduce it now. Just go back to six a day and see if you still have the benefits in the knees and joints Pt: Oh my knees have never been so good because after the operation I was sore but, ahh, you know, you wouldn't worry about it. No pain now! No! Course that's all I need for it to hurt. They shouldn't hurt as much as they did before GP: I think we'll work on getting this back fixed so we can get the sugars – get you a bit more active again - so we can get the sugar under control [pause] Certain exercises that is the key to controlling blood sugars. Cos your diet's been stable, loosing weight despite not exercising, your blood pressures excellent – better than it has been and you can try and wean off those anti-inflammatory tablets just a little bit. You're up to date with blood tests so in six months you probably need to do that? Pt: Six monthly GP: That diabetes control one especially, HbA1c Pt: Hmm GP: Ok Pt: Yep!

5.1.1.3 Table 5.3: Consultation 3 - GP 2, Patient 1, with use of Smart ID Information System

Visual	Verbal
GPs office of consultation GP x 1 enters office and stands near door Pt x1 enters office and sits in chair adjacent to desk GP sits in chair in front of desk and picks up pts paper-based from desk  GP reads pt's paper-based notes whilst talking to pt Pt gives I-key to GP GP inserts his own I-key into USB port on end of extension cord on desk, waits a few moments then removes his I-key. GP inserts pt's I-key into same USB port, waits a few	GP: How are you [Pt's name]? Pt: Not bad GP: Are you actually all right? Are you getting any pains today? Pt: No it's been pretty good GP: Everythings under control – you had some trouble with your breathing at one stage but it's behaving itself? Pt: Cleared up, yeah. I had a bit of a cold early last week but it's cleared up. GP: Ahuh! Last time I saw you, you had a bit of a chest. Did the antibiotics settle it down? Pt: Yeah GP: Ok. Well today I'm surposed to make sure everything is ok with your diabetes. Can you remember when the last time you had a blood test would have been? Pt: I can't remember off hand but it would have been quite a while ago. GP: Do you think it would be more than six months? Pt: Possibly would be GP: Because at least twice a year we need to do a blood test and check what your sugar's like Pt: I've been checking my own periodically and it varies. GP: How often are you doing it? Pt: Every couple of days and I do it at different times. It varies from 5 to 7. The highest its got to is 8 GP: Yeah that's pretty good. Twice a year we should do a blood test so at the end of it I'll give you a form to have that done Pt: Yeah well I'm booked in for a blood test in a fortnight's time that's for everything GP: Right, have I already given you the form? Pt: Yeah. GP: Good. I'm sure we would have put all the usual things on it that we have to do. Did it include a urine in there? Pt: I think so GP: Yeah, have you got a jar? Pt: Yes GP: Today I just need to check your blood pressure and weigh you. I might actually get you to pass some urine if you think you can. Now can I have your key? Just bear with me till I get to where I'm going. I'll put mine in. [pause] Put yours in. While its thinking I'll do your blood pressure

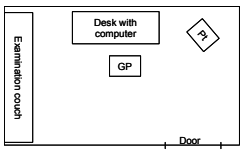
Visual	Verbal
moments then removes it and returns I-key to the pt who puts it in his breast pocket. Whilst computer system is processing request GP prepares to take pt's BP. Pt puts his right arm on desk GP wraps cuff around pt's arm. GP inserts stethoscope into his ears. GP takes pt's BP, then removes sphygmomanometer cuff from pts arm and stethoscope from his ears [computer system comes up]	GP: Oh good it's come up. That's not too bad. 145 over 75. They keep moving the goal posts for diabetics and in theory it could be a little bit better but that's a lot better than it has been on other occasions
Pt removes sandals and walks over to weighing scales. Pt weighs self [Out of camera view] GP follows pt over to scales, notes pt's weight [Out of camera view] and returns to seat. GP then writes result in pt's paper-based notes Pt returns to seat and puts sandals back on.	GP: Uhmm, the other thing I need to do is weigh you. Can I just get you to take your shoes off and stand on the scales over there GP: 88.2. Is your weight pretty stable at present? Pt: Oh yes. I'm on a very low fat diet. I sought of go down a bit then come up a bit GP: Yeah but you're not getting more all the time? What is your slightest weight in the last five to 10 years? What's the least you've weighed? Pt: Golly, [pause] probably about 84, somewhere like that GP: So you haven't been much different? You haven't been a lot less than what you are now? Pt: No not for a long time. Not since I had that operation in Gunnedah. After the operation I did put it on because I didn't get much exercise. But since then it's been staying stable GP: Yeah. When the computer starts to work I'll enter those numbers in
GP writes a referral to his practice nurse to assess condition of blood circulation in pt's feet and gives it to pt	Pt: Yep GP: Has my nurse here checked your feet in the last year? She usually asks you to take your socks and sticks a [trails off] Pt: No GP: Then I'll make sure she does that then. Maybe next visit. And has she done one of those ultrasound things to check the circulation of your feet? Pt: No GP: What I might get you to do along the way is to see Helen

Visual	Verbal
	down the track. Do you see a podiatrist ever? Pt: No I haven't GP: We think it's a good idea for diabetics at least once a year. Pt: I got that thing removed – remember you took it out and its grown back. GP: Did I give you a referral to see somebody then? Pt: No.
Pt again removes sandals GP examines pt's foot Computer system comes up	GP: Let me quickly have a look Pt: I'm going away for a little while in a fortnight's time. GP: And what did I do? Did I cut it out? Did I put a little dressing on it and spoon it out? Pt: You put a poultice on it to draw it and then you uhmm when I came back you cut it out with a scalpel GP: How long after that did I- did it go for a period of time and then come back?
GP writes comments in pt's paper-based notes	Pt: A good month or so before I could feel it. Sometimes I just pick the head off. It gets a hard head on it and it just comes off. The whole thing seems to be up in the foot. It I tread on a stone or something it hurts
Pt puts his sandal back on	GP: Yes, yes, they can be really tricky things. You can put your shoe back on. Uhmm, you're going away when? Pt: In a fortnight's time and going away for about a fortnight. GP: Uhmm either I can send you to a surgeon. The trouble with this is of course to do it the way the surgeons do it – they put you out and it seems like a sledgehammer to squash a fly. Alternatively if I do that, if I do that again but then in three weeks time check it again and if there's any suggestion that there's any root there then I'd redo it 99 times out of a 100. Our mistake probably was a month into it not hitting in again. Pt: Yeah, yeah, well you only did it the once GP: Yeah, once, it seems, wasn't enough. It must have been deeper. Sometimes it's deeper than what I can see. So sometime on a Wednesday if you make an appointment I'll start the ball rolling again.
GP writes comments in pt's paper-based notes	Pt: Ok. Its not that much of an issue but it's just if I'm wearing soft soled shoes and I tread on a stone it hurts GP: Yes they can be quite painful and sometime in the next two or three months I'll need to organize an appointment with Helen. For all diabetics we like to do a foot check and I have a couple of nurses that I delegate that to so I'm not doing everything Pt: Yes alright GP: Helen will check sensation and circulation and make sure you don't need a podiatrist. Medication wise. Nothing that you're on at present bothering you is it? Pt: No, it's all working pretty well I think GP: Do you need any today?

Visual	Verbal
	Pt: No, I'm pretty right GP: Do you feel up to doing a urine sample? Pt: Uhmm, yeah! I'll give it a go yeah. GP: Well we might leave that till the very end. Pt: Yeah, ok GP: I'll give you a form to get the blood test done, now lets see when they were last done. [pause] But actually you've already got the forms. I'm pretty sure I would have done all the standard things for that Pt: I think so because you gave [person's name] the form and she came to see me and said you said this is for me GP: Make an appointment for a month, make it on a Friday if you can and you can see Helen first and do foot test and then see me and I'll make sure your results are alright. And an eye check. When have you had an eye check? Pt: Uhmm I'm due. I have an appointment now which is with the same guy I went to before. A specialist. GP: Bryce is it? Pt: Arh yes I think it is and he couldn't see me for oh [trails off] GP: I know his waiting list is three or four months I think. What I'll do is, uhmm, you can do a drop of urine now and leave it at the desk and I'll check it and if there's anything wrong with it I'll let you know
GP gives pt a urine sample container writing pts name on label of container	Pt: Ok GP: Alright, so an appointment in about a month for me to follow up those results and a Friday if possible , and if you give them those bits of paper they'll book you in to Helen and then you'll see me and the other piece of paper is for Wednesday for your foot.
GP enters pt's weight in CPR, then reads pt's CPR GP enters pt's BP in CPR	GP: I'm just going to do one thing I haven't done and that is enter into here your weight – 88.2. Do you know how tall you are? Does 169 centimetres sound right? Pt: Yes, that sounds right GP: The computer tells me you are in the overweight range Pt: Overweight,yeah GP: So I guess that's just do what you can. If Helen can give you some pointers when you see her then well and good. Pt: Yeah GP: I'm just going to put your blood pressure in – 145 over 75.
GP shakes pts hand. Both GP and pt simultaneously rise from their chairs. GP shows pt to door of consultation office. Pt exits. GP exits.	GP: Ok, thanks [pt's name]. Good of you to come. So I'll see you on Wednesday when you come back from holidays and also on a Friday about that other thing Pt: Ok GP: Tat ta

Note: GP was trying to read system messages such as error messages on computer screen whilst consulting with patient. Interface was not part of assessment.

5.1.1.4 Table 5.4: Consultation 4 - GP 2, Patient 2, without use of Smart ID Information System

Visual	Verbal
GPs office of consultation GP x 1 enters office bringing pt's paper-based not with him and stands near door Pt x 1 enters office and sits in chair adjacent to desk GP closes door and sits in chair in front of desk reading Pt's paper-based notes	GP: Come in, have a seat, thanks for coming. This is to do with your diabetes and to make sure I've done all the things I'm surposed to do in making sure that your diabetes is not going to bother you in any way. Pt: Ahha. GP: Do you remember when the last time I did a blood test on you might be? Pt: No GP: Because you were seeing Helen for a while and she was doing the pin pricks -
	Pt: Oh she does that yeah GP: - because your eyes are bad and you can't do them yourself but, uhmm. Pt: You gave me a slip of paper to go over across the road, uhmm, around the first week in December. GP: Oh ok, I must have worked out last time when you were due. Pt: I think it had the 5th on it GP: Do you remember if that includes a urine test? Pt: No it didn't say anything about urine test
GP brings up pt's CPR and checks in it when it was last done	GP: I'll just see when we done that last. Uhmm, yes, we done one of those in January of this year so the next one's due in a couple of months but we can organize that again. So I'll just make a note that we've still got to do that. Your sugars that have been checked by Helen lately have all been pretty reasonable haven't they since starting taking the new medication Pt: Just that tablet. [inaudible] GP: It's excellent isn't it? Well, we can keep you on that until it comes on the free list Pt: You think it will GP: Pretty sure because it's so good. Pt: Oh I see. GP: And so I think in fact we may be able to reduce some of the other medication in due course but I won't upset it right now because you've been so good but if it stays good we'll cut back maybe the amaryl. Who knows we might even be able to [trails off]. I mean you're on four diabetic tablets which is an awful lot
GP writes comments in pts paper-based notes	Pt: And I don't know which one it is, I was talking to the chemist yesterday. He said it could be the avapro. I go to the toilet four times during the night and after I've been I can't get back to sleep.
GP prepares to take pt's BP. Pt puts her right arm on desk GP wraps cuff around pt's arm. GP inserts stethoscope	GP: Yes it could be the fluid component of the avapro. I'd put my money on the diuretic part of the avapro. So if your blood pressure is alright we might be able to cut back on

Visual	Verbal
into his ears. GP takes pt's BP, then removes sphygmomanometer cuff from pts arm and stethoscope from his ears	that a bit. The other thing I need to do is weigh you. Is your weight stable at present? Pt: Oh it was for a while there but you got me eating breakfast so I come back up again GP: You don't normally eat breakfast? Pt: Only little piece of toast and cup of tea. Now I have two pieces of toast and an egg or some baked beans on toast, something like that or sardines. GP: It's got to be better for you. It might be why your diabetes is better controlled because you've been eating better
GP writes comments in pts paper-based notes	Pt: I'm careful. I cheat occasionally and have a piece of chocolate or a piece of cake. But I am pretty careful GP: Yeah your blood pressure's good today. 120 on 80. That's better than what I've got the last couple of times. If get this good result again I'll let you change the Avopro. Uhmm sometimes your blood pressure can be a little bit up. I'll just put that in here. The other thing I need to do is weigh you I might get you to slip out of those scuffs and pop on there?
GP walks with pt to scales, observes pt's weight then returns to his seat Pt returns to her seat	Pt: I was loosing a little bit each week GP: You are about the same. Pt: About the same as last time GP: You don't need any of your medication today?
GP reads pt's paper based notes	Pt: No, I have a list written down of what I'll need for my next visit GP: Now Helen's checked your feet by doing that pin prick test Pt: Yes, she said it was good GP: Good and I know we've done the circulation on your legs because you've had dopplers about a year ago. I think we said we had to repeat a Doppler early next year on your tummy because of the aneurysm you've got. Uhmm, and the only other thing is your eyes. You see an eye doctor?
GP enters pt's BP and weight into pt's CPR	Pt: I see Dr [name] GP: When are you seeing him again? Do you see him every year? Pt: Yes once a year GP: Do I need to give you a referral? Pt: I surpose it would be best. I did tell him last time in case the sugars [trails off]
GP flicks through pt's paper-based notes looking for eye specialist's letter	GP: Do you think you've seen him this year? [pause] Here it is. [pause] No, that's not it. Look I might ask you to ring Dr [name] rooms and see when the year's up because with that macular degeneration and your diabetes I think you need to see him every year. Now has Helen checked your urine on some of those visits? Pt: No
GP gives pt a specimen container writing pts name on label of container	GP: I might give you a container and next time you come after those round of blood tests just bring us an early morning one when you come Pt: Right. Bring it here?

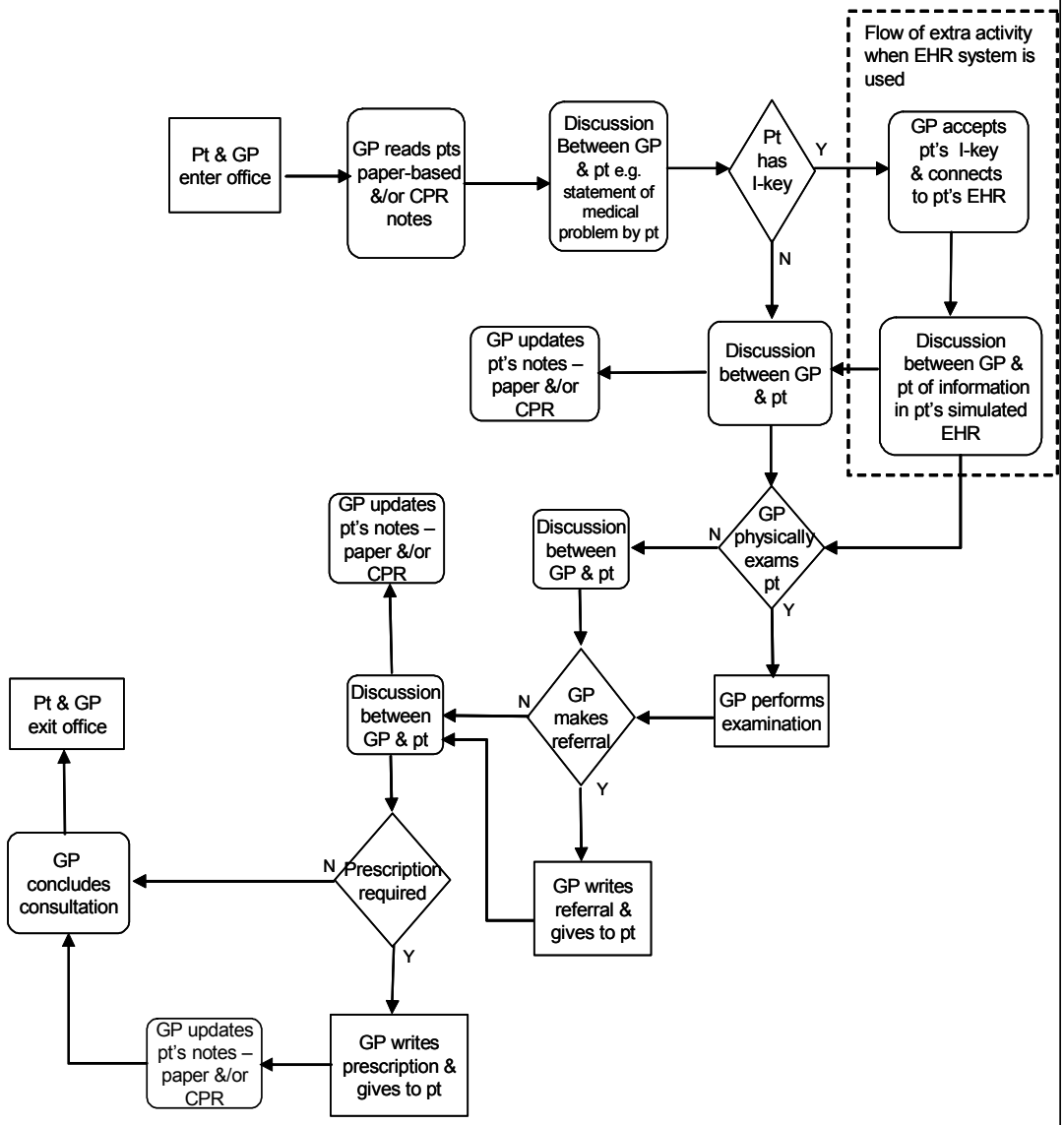
Visual	Verbal
	GP: Yes!
Pt stands up	Pt: Ok
GP stands up	GP: That's everything. Thanks very much for coming. It's very kind of you
Pt exits	
GP exits	Pt: Oh that's alright. That's it, nothing more?
	GP: Nothing more.

5.1.2 Flowchart of Consultations

The following flow chart shows the key tasks performed during the consultations. In order to present a summary of all four consultations it was necessary to constrain the level of detail in the flow chart. Although each consultation followed the same lines, each consultation was different because each patient was different presenting with different problems. Therefore, each consultation was personalized not only by the GP to the individual patient, but also by the patient himself or herself to his or her individual needs. This personalization became illuminated in the previous tables.

Fig 5.1 Flowchart With Summarised Work Practice During Consultations Showing Use With and Without Pilot EHR System - Based on Results From Videotaped Consultations During Current Research

Karolyn Spinks, University of Wollongong, 2005



Assumptions

Pt = patient
Pt has previously been diagnosed with diabetes mellitus
Pt is treatment compliant
Pt is known to GP and has been recalled for follow-up appointment
GP has all necessary hardware and software in place for use of IT
GP is involved in IDGP's diabetes research program
GP is involved in Smart ID Information System project (pilot EHR system)

5.2 Analysis and Discussion of Results from Observation Study

5.2.1 Analysis of Tables

Comparison of the four consultations (Tables 1-4), illuminated the following key findings. Firstly, in each of the four consultations (Tables 1-4), the GP spent a similar amount of time in direct patient care whether using the system or not using the system. During consultation one (Table 1), in which the Smart ID Information system was used and which the system had patient information, more time was spent in interpreting information from the patient's diabetic record during the consultation than discussing other issues. Whereas a similar amount of time was spent in the other three consultations (Tables 2-4), but these consultations also included discussing different issues.

Secondly, during consultation one (Table 1), in which remote information was accessed, review of the videotape strongly highlighted the occurrence of much more mutual discussion between patient and GP (Spinks et al, 2003). With EHRs the literature states it is important that this discussion remains therapeutic (APA 1999). That it is not made vulnerable by potential information privacy invasion and poor security of EHRs. This aspect of EHRs and GPs' work practices is examined more fully later in the chapter in section 5.2.2.

The occurrence of this mutual discussion could also be described as more joint involvement, or more teamwork between patient and GP. The use of the I-key facilitated increased mutual discussion because the I-key allowed access to remote patient information where normally this information is not available when the patient attends a GP who is not their regular GP. In such a situation where remote patient information is not easily accessible or available, incidence of errors may be higher and patient care may be less complete (Fischer and Blonde 1999, Heard S., Grivel T., et al (2000) p23, 31). Errors can occur because the GP must work within the information limitations. During consultation one (Table 1), the discussion focused around the

patient's pathology results that were held in the IDGP's diabetes database with both the patient and GP enthusiastically contributing to the discussion (Spinks et al, 2003). Specific pathology results that were discussed were tests performed for:

- HbA1c (A measurement of glycosylated haemoglobin that gives a useful indication of average blood glucose levels over an extended period of time; is a good monitor of long-term control of diabetes).
- HDL (high-density lipoproteins or also known as "good cholesterol ", or "healthy" cholesterol. HDL is a type of blood fat).
- Cholesterol (Total cholesterol including "good and bad cholesterol". This is also a type of blood fat.)
- Triglycerides (This is another type of blood fat, the name of which comes from the chemical structure of the fat).

The latter three HDL, Cholesterol and Triglycerides provide a lipid (or fat) profile. Monitoring and managing one's own lipid profile is crucial to good management of diabetes and therefore of one's overall health. The lipid profile is something that patients themselves can influence through diet and exercise. Increased involvement by patients during consultations may lead to increased management in their own care and may promote a greater consumer focus in healthcare (Heard S., Grivel T., et al (2000) p1, 17). This may be especially beneficial for patients with chronic disease, such as diabetes, and GPs who must care for such patients. The need to manage chronic disease is demanding for GPs because of the need to liaise with numerous other health service providers and allied healthcare professionals on a long-term basis (GPB DHAC 2000). In chronic disease it is essential continuity of care is maintained. Managing chronic disease is also increasingly demanding due to Australia's aging population.

GPs have a complex role in that not only must they manage acute and chronic types of illness they must also balance each individual patient's therapeutic care with population based preventative heath (GPB DHAC, 2000). They must also respond to the changing needs of more informed patients who have high expectations for their quality of care.

Other results also accessed and generated by all the GPs were the patient's height, weight and blood pressure (Tables 1-4).

A second key finding was the variance in the length of consultations (Spinks et al, 2003). Both consultations which used the Smart ID Information System (Tables 1 & 3), were longer than the consultations that didn't (Tables 2 & 4). Consultation one (Table 1) in which the I-key was used was 12 minutes long. Consultation two (Table 2), where the I-key was not used was 10 minutes long. Consultation three (Table 3), in which the I-key was used was 14 minutes. Consultation four (Table 4), where no I-key was used was eight minutes. The two-minute time difference between consultations one and two (Tables 1 & 2), both with GP one, and the six minute time difference between consultations three and four (Tables 3 & 4), both with GP two, is attributed to a combination of time the Smart-ID Information System took to load in the different surgeries and discussion time between GP and patient. It is appropriate to note at this point however, that consultation length is also influenced by other factors, such as, how ill a patient is, patient personality, GP personality.

In consultation three (Table 3), although the system loaded satisfactorily and accessed the patient's record in IDGP's diabetes database there was no patient information in it due to problems with data being uploaded to it from the patient's CPR (Medical Director) from the GP's surgery. Nevertheless, the consent process for accessing the patient's records via use of the I-key in consultations one and three (Tables 1 & 3) was not a factor which caused delay. This consent and access process was simple, and quick. This was probably because each GP and patient was familiar with and compliant with the concept of accessing patient information held in EHRs via I-keys. Prior to the Smart ID Information System being used during consultations the GPs had received training in the use of accessing records with I-keys.

The use of the I-key which contained the unique identifier, similar to a UPI, successfully accessed the patients records held on IDGP's database for consultations one and three (Tables 1 & 3). As stated above the consent and access procedure was

quick and simple. Nevertheless the unique identifier was the vital mechanism needed for the automated matching of the patient's information (Spinks et al, 2003). This result gives support to NSW MACPHI suggestion that without a UPI there is no reliable way of uniquely identifying patients' EHRs (NSW MACPHI 2000, p10). It also lends support to the idea by Appavu (1997) who says that UPIs are accepted by many stakeholders for their data matching and authentication capabilities.

During the loading time of the system in consultations one and three (Tables 1 & 3), the GPs took the opportunity to read the patient's paper-based notes, organize stationary, talk with the patient and write in the patient's paper-based notes. The time it took for the Smart-ID Information system to load in consultation one (Table 1) was measured to be two minutes. In consultation three (Table 3), with GP two, system loading time was one minute. It is possible these long loading times were due to the modems used in the GP's surgeries and the numerous steps required to access the information over the network. The number of steps involved included: from the GP to the GP's desktop computer, to GP's file server within the surgery (if present), to ISP, to Illawarra Health's file server including through Illawarra Health's firewall, to IDGP's file server including through IDGP's firewall, finally to IDGP's diabetes database. Figure 5.2 below shows a graphical representation of accessing the information over the network. If no file server was present at the GP's surgery, the number of steps was reduced to five, however five steps caused a significant delay in system loading time.

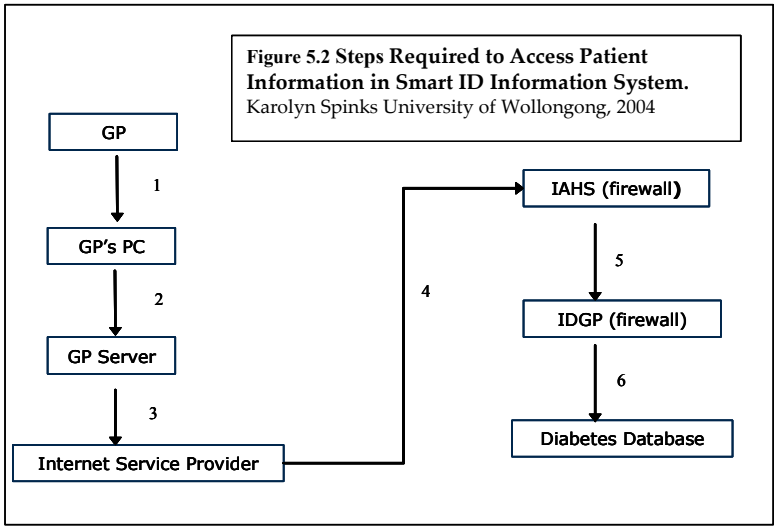


Figure 5.2 Steps Required to Access Patient Information in Smart ID Information System.
Karolyn Spinks University of Wollongong, 2004

The delay in system loading time could cause consultations to lengthen. This could affect the throughput of the number of patients and may be unacceptable to GPs. The length of consultation is a major issue in EHR (Health*Connect* Program Office, 2003, vol 3, part 3, p27).

The results on consultation time variance are similar to results from the Health*Connect* Tasmanian trial (Health*Connect* Program Office, 2003, vol 3, part 3, p52). The time required for GPs connecting to Health*Connect* ranged from 20 – 120 seconds, average 60 seconds. The time spent viewing EHR information ranged from 30 – 180 seconds, average 120 seconds. The time spent completing a patient's event summary ranged from 30 – 120 seconds, average 50 seconds. Average total time for connecting, viewing information and completing an event summary in the Health*Connect* Tasmanian trial was 60 + 120 + 50 seconds = 230 seconds, or 3.8 minutes. Worst-case scenario was 420 seconds, or 7 minutes (120 + 180 + 120). Best-case scenario was 80 seconds, or 1.2 minutes (20 + 30 + 30).

No results from the Health*Connect* Tasmanian trial on the total length of consultation time with EHR in use were available at the time of writing this thesis. However, there were results relating to the GP's dissatisfaction with Health*Connects* EHR system performance. GPs were reported to be constrained by the slowness of Health*Connect* in providing information. They initially tried to use the system during consultation but were disappointed with its response to the point where they stopped using the system (Health*Connect* Program Office, 2003, vol 3, part 3, p27). This dissatisfaction together with the figures from above seem to indicate that using Health*Connect* was causing the consultation to become too long. A longer consultation for every patient means at the end of the day the GP cannot consult to as many patients within the same timeframe. Total throughput of number of patients is reduced. It is unlikely this will be acceptable by GPs.

The GP and or the GP's reception staff may no longer need to spend as much time chasing patient results and patient histories as traditionally done before the introduction of EHRs. For the GP with the introduction of EHRs now that time is

absorbed into each consultation and may result in more discussion and more efffective consultations.

Traditionally, locating patient results can sometimes take the GP away from the patient. But because the information, for example in the case of the current research, pathology results, was already there, the GP no longer needed to leave the patient to find them. Evidence in the literature states consultation length is an important consideration in a busy healthcare system. Care is and must be taken so that consultations do not run over their allotted time allowance (Kindberg et al 1999). Time saving change in work practices of no longer needing to seek patient results as evidenced by the current research could shorten consultation times (Spinks et al, 2003).

Conversely, the use of EHRs in private practice may increase consultation times as again evidenced by the current research (Spinks et al, 2003). This increase in consultation times may be due to two reasons. Firstly, more clinical information being available on which to base discussion. Secondly, dependence on prevailing technology in use at the time influences length of consultation. One strategy to minimize this disruption to GPs' work practices and length of consultation could be the use of broadband telecommunication technology that would significantly improve system loading and system response time. The use of broadband technology is the chosen telecommunication bandwidth to improve performance of Health*Connect* EHR system (Commonwealth DHA, 2004).

A third finding is the consultations with the I-key (Tables 1 & 3), flowed well, as did the consultations without the I-key (Tables 2 & 4). There appeared to be no noticeable disjointedness between the consultations in the way the two GPs worked during their two consultations each when accessing the remote patient information and performing their usual investigations such as recording of blood pressure and weight (Spinks et al, 2003). The use of the Smart ID Information System, including the use of the I-key in consultations one and three (Tables 1 & 3), did not appear to impinge on the GP's flexibility and autonomy of their personal work practices. These results agree with

similar results found in the literature in the Health*Connect* Tasmanian trial (Health*Connect* Program Office 2003, vol 3, part 3, p55).

The use of the I-key to obtain the patient's consent to access their information held on IDGP's database highlighted a change in the GP's work practices. These results reinforce that which was suggested in the literature by Health*Connect* Program Office (2003, vol 3, prt 3, p68) which stated when GPs use EHRs their work practices will change due to the need to routinely obtain a patient's consent to access that patient's EHR.

Fourthly, although it did not happen during the consultations in which the I-keys were used (Tables 1 & 3), there is the potential for patients to leave their I-key behind or accidentally exchange their I-key with the doctor's I-key. A recommendation to avoid accidental exchange of I-keys is the use of colour-coded I-keys. For example, white for a GP's I-key and red for a patient's I-key. This idea would work similarly with smart cards i.e. colour-coded smart cards.

A fifth finding illuminated the need for easy access to the USB port in which the I-keys were inserted during consultations one and three (Tables 1 & 3) (Spinks et al, 2003). In the case of the current research the I-key plugged into a USB port on an extension cable which enabled easy insertion of the I-keys on the GPs desk. This was necessary because the USB ports were located at the back of the GP's computer. Placement of each cable was done prior to the consultations during the installation of the Smart ID Information System. Even with later models of computer hardware, where USB ports are positioned at the front of computers for example, extension USB cables may still be necessary if the computer is located out of easy reach.

The sixth finding relates to work practices and ergonomics. Specifically, this is positioning of the computer screen in relation to the GP and the patient (Spinks et al, 2003). All consultations (Tables 1-4), highlighted the patients' positions were poor in relation to discussing information on the computer screen because the patients sat directly adjacent to the computer monitor and could not easily see the screen. GP one encouraged the patient to read information on the screen and swiveled the monitor to

facilitate this. However this position was still poor for viewing and to view the screen the patients sat half on and half off the chair and twisted their neck. Thus positioning of the GP's furniture, especially the patient's chair in relation to the monitor (Table 2), is important. In consultation two (Table 2), even though the Smart ID Information System was not used the patient read his information on the CPR and watched the screensaver. This patient was suffering from a painful back problem at the time.

It is not uncommon for a patient to sit opposite the GP at the other side of the desk thus again highlighting the ergonomics issue. Even with swivel based monitors and laptops, such a configuration may not be conducive in allowing the GP or patient to easily view the information on the screen at the same time. Every GP's office is configured differently in terms of the layout of furniture, space available, shape of the office, so each surgery would need individual assessment. Environmental aspects of the GP's workplace do affect GPs' work practices so assessment of the ergonomics in the workplace is a valid area for investigation. One possible solution to this ergonomics problem with EHRs could be the use of two separate monitors from which to view the patient information – one for the GP and one for the patient. However, this solution may prove unacceptable to GPs due to the added expense and GPs wishing to protect patients from the risk of premature disclosure to sensitive patient information (Emery et al 1999).

A seventh finding is that consultations three and four (Tables 3 & 4) highlighted some of the existing problems with GP's daily work practices whereby GPs rely on the patient's memory to ascertain what treatment has been previously administered. This is shown, for example, in this segment taken from consultation four (Table 4):

> GP: "Do you think you've seen him this year? [pause] Here it is. [pause] No, that's not it. Look I might ask you to ring Dr [name] rooms and see when the year's up because with that macular degeneration and your diabetes …".
>
> GP participant during consultation

This finding reinforces the results from the previous chapter (chapter 4) where GPs reported they perceived a problem with unavailability of patient information.

An eighth and final finding is that greater patient satisfaction is a likely outcome from the introduction of EHRs in general practice (Spinks et al, 2003). Upon discussing his lipid profile results with the doctor, at the end of the consultation one (Table 1), patient one was quoted as saying, "I'm happy with the results", referring to the lipid profile and other diabetic results. Thus patients may perceive they may get more value from their consultation.

With the increased teamwork between patient and GP afforded with EHRs as evidenced in consultation one (Table 1), there is the potential for improved relationships between patient and GP although consideration must be given to other factors that may influence the relationship between patient and GP. For example, personality compatibility between GP and patient and patient enthusiasm of wanting to be involved in care.

These results of increased teamwork between patient and GP in consultation one (Table 1), and the potential for improved relationships between patient and GP are on the one hand contrary to what other studies have found. Leung et al (2004), for example, found although Hong Kong physicians considered computers do have beneficial effects on many aspects of clinical patient care, they also perceived there were negative effects especially on the human component of the practice of medicine, that computerized consultations have negative effects on the rapport between doctors and patients. Another study by Thakurdas et al (1996) in Leung et al, (2004) identified that many New Zealand physicians articulated fears that computers may impede doctor—patient communication. In the current research results showed clinical computerization via CPRs and use of the pilot EHR system (Smart ID Information System) positively impacted the GP-patient relationship through increased mutual discussion and joint involvement during the consultation.

On the other hand, these results of increased teamwork between patient and GP from consultation one (Table 1), and the potential for improved relationships between patient and GP concord with findings of other studies (Cooling, Kidd and Sloggett,

1997). Research by Cooling, Kidd and Sloggett (1997) indicated GPs' use of computers for patient education during face-to-face consultations had a synergistic effect with patient understanding and GP-patient interaction. Cooling, Kidd and Sloggett (1997) also said there was growing evidence that patients with access to health information participate more in their treatment and have healthier outcomes. In fact Cooling, Kidd and Sloggett (1997) reported because consumers were becoming more educated and computer literate overall there was an expectation by consumers for GPs to respond to requests for involvement in management decisions, informed consent and evidence based medical information (Cooling, Kidd and Sloggett 1997).

5.2.2 Analysis of Flowchart

Analysis of the flowchart of summarised work practices indicated the common event to all four consultations was discussion. Discussion occurred early and frequently. Discussion directly influenced tasks that were undertaken. For example, such discussion between the GP and the patient determined whether the GP made a referral or not. Such discussion may be jeopardized by EHRs if security and information privacy is mismanaged. Threat to the therapeutic doctor-patient relationship was expressed as a concern by the APA (1999). The literature reported by Davidson (2004), Woodhead (2002) in Cornwall (2002 p4), Bennett (2001), explained new legislative measures taken such as the NSW HRIP Act 2002, National Health Privacy Code, and NSW Health Information Privacy Code of Practice, which will all greatly improve the correct handling of security and information privacy and reduce GPs' and patients' concerns for information privacy invasion and security mismanagement. These measures should thus help to maintain the therapeutic doctor-patient relationship.

5.2.3 Analysis of Follow-up Interviews From Secondary Data

Follow-up GP interviews on GPs' perceptions of the Smart ID Information System after it was trialed were undertaken by O. Jovanovski (2002) a fellow researcher involved with the system project. Results from those interviews (provided in appendix H) showed although GPs found the system at the time too limited the GPs were supportive of the concept behind the Smart ID Information System. The GPs said the

system facilitated an improvement to access of patient information (Bomba et al, 2004) and an improvement in communication between medical services. Furthermore, the GPs interviewed stated they believed the Smart ID Information System had potential to improve team management of complex medical conditions. They said they supported further development of such systems because such systems will stop duplication of tests, and "[such systems] are the way of the future", (Jovanovski, 2002).

The GPs said trialing such a system highlighted to them the benefit of the "promise of things to come". Also, GPs thought that significant advantages would materialize when they could get access to more information from such a system. Indeed, the GP stated the more medical professionals and patients using the system the greater its value (Jovanovski, 2002).

Of the GPs interviewed one GP thought consultations were longer, a second GP thought the length of consultations stayed the same. The GPs said the most negative aspect of the Smart ID Information System was getting the technology to work but once the technical problems were overcome the system worked well. GPs interviewed thought the system provided good privacy functionality because patients chose who accessed their information (Jovanovski, 2002).

5.3 Conclusion

The evidentiary base of videotaped data for the observation study included results from two separate GP practices. The chapter's purpose was to present a synthesis and aggregation of the results from each GP whilst preserving their and their patient's anonymity. This synthesis has been achieved through the presentation of the results in tabular form rather than pictorial shots. Aggregation of the results were presented through the flow chart.

The specific research objective for the observation study from section 1.4.2 was:

4. to assess general practitioners' daily clinical work practices during consultations highlighting the difference in how a GP works with and without

EHRs and UPIs via use of the Smart ID Information System with I-keys as the access device.

The study has met the research objective outlined at the beginning of the thesis in the following ways. The difference in how a GP works on a daily basis during consultations with and without IT - using a pilot EHR in the form of a Smart ID Information System, - has been assessed and shown by presentation of the results of observed GPs' work practices in tabular form and a flowchart. Noting the impact EHRs have on these work practices has been analysed and discussed. Provided EHRs do not greatly lengthen consultation times and such a system runs efficiently, GPs are reasonably comfortable with the impact the same has on their work practices. Some of the problems with GP's daily work practices have been reiterated such as GPs relying on the patient's memory to ascertain what treatment has been previously administered (Table 4). Results of follow-up interviews from secondary data by Jovanovski (2002) indicate GPs are willing to accept the technology knowing the benefits they will gain from its use.

Recommendations for minimising disruption to a GP's work practice when introducing technologies which access external patient information repositories has been given, such as, the use of broadband technology, use of colour-coded I-keys and dual monitors.

The results of the observation study support what is said in the literature regarding benefits for doctors and patients in general practice. Such a benefit reported in the literature was improved and appropriate access to patient health records drawn from the capacity to share patient data (Heard and Grivel et al, 2000, p 23-38). This benefit may lead to less frustration and real improvements in work practices for health service providers. Another such reported benefit derived from more streamlined work practices was resultant improvement in doctor productivity and satisfaction (Heard and Grivel et al 2000).

6 Summary of all Research Results, General Conclusion and Further Research

6.1 Summary of all Research Results

Results of the perception study from chapter four showed GPs agreed there was a problem with exchanging patient information and were keen to increase the amount of patient information exchanged. In general, they were willing to use IT in the form of EHRs. They believed the use of IT through implementation of EHRs, could help provide a solution which overcame the existing problem of lack of patient information. The GPs highlighted the EHR system implemented must be simple to use.

Results of the observation study from chapter five showed GPs successfully used the pilot EHR system within their consulting environment. The access and consent procedure facilitated via the I-keys was quick and simple to use despite slow system performance. The GPs proved they could successfully access the patient's record, integrate this access procedure and subsequent discussion of the information with the patient, into the consultation whilst maintaining their autonomy for their personal routine and work practices. Both consultations in which the system was used were longer.

Results of follow-up GP interviews from secondary data by Jovanovski (2002) indicated although GPs found that the Smart ID Information System was too limited in the type of information it offered they thought the pilot EHR system was a good idea in principle. The GPs said the system facilitated an improvement to access of patient information and an improvement in communication between medical services. Furthermore, the GPs interviewed stated they believed the pilot EHR system (Smart ID Information System) had potential to improve team management of complex medical conditions. They said they supported further development of such systems. After using the Smart ID Information System, one GP thought consultations were longer, a second GP thought consultation length stayed the same (Jovanovski, 2002).

6.2 General Conclusion

This research was conducted to understand the association between the use of EHRs and changes (if any) on the way general practitioners work. Results were drawn and conclusions made through interviewing and observation of general practitioners working during consultations with supplementary results from a closely related study. The current research was qualitative and observationary in nature. Due to the small sample size, claims of representativeness or generalizations from the results to the wider context have been minimised whilst balancing discussion of implications of EHRs and general practice within the broader healthcare and IT environment. Convenience samplying used may have placed biases in the results. Measures were taken throughout the research to minimize bias. The thesis achieved the research aim and objectives by utilizing a linear-analytic structure for the thesis format.

6.2.1 How The Thesis Achieved Its Research Aim and Objectives

The main research aim was to assess the impact of IT, specifically EHRs on GPs' clinical work practices. The research achieved this by assessing GPs' perceptions of accessibility to clinical patient information and observing GPs' use of EHRs during patient consultations through the use of a pilot EHR, the Smart ID Information System.

The specific research objectives were:

1. to determine if GPs perceive a problem with the exchange of patient information between GPs and other health service providers
2. to understand issues/problems facing GPs prior to the implementation of pilot EHRs via a micro project in general practice: Smart ID Information System
3. to ascertain GPs' perceived benefits/risks of using a pilot EHR: Smart ID Information System, using UPIs in conjunction with a portable electronic device, to access patient records and exchange healthcare information between health service providers
4. to assess general practitioners' daily clinical work practices during consultations highlighting the difference in how a GP works with and without

EHRs and UPIs via using the Smart ID Information System with I-keys as the access device

The research has addressed the four objectives of the study in the following ways. The research has examined issues and problems facing GPs with the way patient information is currently exchanged between GPs and health service providers. It has highlighted the needs/issues and problems of the selected group of GPs in relation to the implementation of EHRs via the Smart ID Information System. Furthermore, the research has elaborated the benefits and risks to GPs of using a pilot EHR, Smart ID information System. The difference in how a GP works on a daily basis during consultations with and without IT - using a pilot EHR in the form of a Smart ID Information System, - has been assessed and shown by presentation of the results of observed GPs' work practices. The impact EHRs have on these work practices has been analysed and discussed. Although results relating to the variation in consultation length with EHRs were inconclusive due to some consultations staying the same and some becoming longer as stated in the previous section 6.1 , 'Summary of all research results', there is the possibility consultation length will increase with EHRs.

Based on the results from the current research, and if EHRs do not significantly lengthen consultation times, such an EHR system runs efficiently, and excellent infrastructure is in place to support GPs, the introduction of EHRs (and UPIs) have minimal impact on GPs work practices. GPs studied were moderately comfortable with the impact the pilot system had on their work practices. These GPs were willing to accept the challenges inherent in the technology knowing the added service value they could provide to patients during consultations without EHRs adversely affecting their work practices. The GPs were aware their work practices were hindered by inefficiencies due to non-availability of patient information. One example where this became apparent was GPs observed relied on the patient's memory to ascertain what treatment had been previously administered. The GPs indicated they would have more to gain than lose with use of EHRs.

Variation in consultation length is due to the individual nature of each consultation where not only EHRs may be used but other mitigating factors such as personalities and degree of illness contribute also to the length of consultations. A large scale quantitative study may be more suited to give conclusive results on this aspect.

Results from the study support the view that the role of GPs is changing whereby the traditional model of the family GP directing diagnosis and deciding treatment is giving way to shared responsibility between patient and doctor. The results from the study also support the view that the patient healthcare record should be promoted as the core object of a primary care information system.

The GPs studied emphasized such a pilot EHR system must be simple to use. Therefore, if the interaction required by GPs for an EHR system is clumsy and time-consuming then the use of EHRs will not be well received by GPs in their day to day work practices. Indeed perhaps the EHR system needs to be seen to operate at the level of phone or fax of which GPs are most familiar. Importantly, when considering GPs' work practices, IT's ability to provide EHRs and information support to GPs needs to be transparent and seamless to meet their needs and expectations. From the results of the current research it appears this is possible.

GPs in the current research were doctors who already used patient management software, Medical Director, during their consultations. Using this software helped them to embrace EHRs. If they had not been familiar with such technology previously, the GPs would have needed to learn this software first then, learn how to use EHRs. Thus this would be a more daunting undertaking, harder for them to learn and possibly may not even have been considered by the GPs. The need to take small steps at a time and not to rush cannot be overemphasized. This is supported in the literature by Liaw & Chan (1993).

Furthermore, the need for education, training and support for GPs in EHRs must not be underestimated. This is because it is essential to consider the degree of uncertainty GPs feel towards EHRs and ICT in general. GPs may need training in how to integrate

the computer and use of EHRs into the consultation so that they feel comfortable with using the computer during the consultation and remain in control of the consultation process. Another method of uncertainty reduction includes a well-defined working situation, ie, provision of a need to use the EHR system (Budd-Lewis and Scerbo, 1996).

As illuminated in the literature (Health*Connect* Program Office, 2003, vols 1,2,3; Heard & Grivel et al 2000), although the exchange of clinical patient information within the healthcare industry and within general practice itself is not satisfactory, there is increasing interest and commitment in making improvements in clinical computerization in general practice, and the overall healthcare system, in Australia for doctors and patients alike. As discussed throughout the thesis, particularly in the literature review, currently the improvements for clinical computerization for general practice, including EHRs, are being 'pushed' from government departments, professional medical bodies, IT and associated telecommunications industries, and enthusiastic groups of general practitioners interested in medical informatics, rather than being 'pulled' by the large body of general practitioner end users. In other words GPs are being asked to use EHRs rather than GPs asking for EHRs. Some of the professional medical bodies encouraging clinical computerization in general practice, including EHRs, are RACGP, AMA, Divisions of General Practice, General Practice Partnership Advisory Council (GPPAC), General Practice Financing Group (GPFG), and General Practice Computing Group (GPCG).

Improved medical record systems, such as EHRs, are essential for improved quality of GPs' work practices both in the management of illness and in supporting an anticipatory care approach to medicine by GPs. Furthermore EHRs are essential for supporting the pivotal role GPs play in the development of coordinated care and ambulatory care, which necessitates a team approach by health service providers. These initiatives involve multidisciplinary care plans and multidisciplinary case conferencing of which GPs are key contributors.

EHRs facilitate the provision of better patient information thereby optimizing opportunities for improved clinical decision making for GPs. One reason this can be

expected for EHRs is because EHRs free GPs from spending valuable time seeking patient records and increases time available for direct patient care activities such as discussion. The thesis provided evidence for this idea by presentation of the results from videotape observation where the pilot EHR system, Smart ID Information System, was used during consultation. GPs were more involved with discussion of patient's results and were liberated from manually seeking the information.

The usage of EHRs in general practice, will definitely promote more integrated use of IT in the daily work routines of general practitioners. The research results showed GPs are starting to become more confident users of IT, although the concept of paperless general practice may still be premature as GPs examined in the current study do have reservations about being reliant on IT. In particular, although GPs acknowledged a need to access patient information whilst outside their surgery, they were not comfortable using mobile wireless devices to do this. Despite these reservations, surgeries will, in the future, perhaps become completely dependent on IT, including mobile wireless devices such as PDAs, to be able to work productively as is currently seen in the banking environment which widely exploits IT capabilities to improve productivity. In our general society already, if one does not use email, one can be overlooked during the communication process.

Whether EHRs will be introduced into general practice or not, the role of primary care is changing due to primary care having a more influential input in preventative medicine supported by a major shift in resources from secondary/tertiary care to primary care and ambulatory care. The focus is aimed at keeping people out of hospital in order to reduce rising health care costs. The relationship of how general practice interfaces to secondary/tertiary care is changing and will no doubt continue to change, in light of initiatives utilizing health informatics concepts. The use of EHRs by GPs is one way to help GPs keep pace with this changing role.

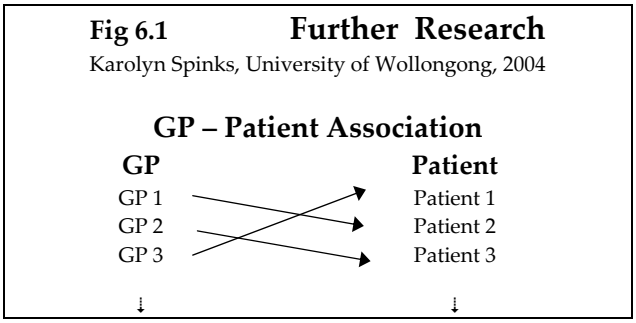
The success of EHRs and any changes brought about by them, will ultimately depend on the commitment of those who must implement the changes including GPs, practice managers, nursing staff and other primary care team members. The successful and

effective introduction of integrated information systems such as EHRs will require a great deal of careful planning including the accurate identification of impact to GPs work practices.

6.3 Suggestions for Further Research

Chapter one in the thesis, section 1.4.3.1, Scope of the Research, stated the current research involved a direct GP – patient relationship. A suggestion of further research of EHRs in general practice could be an extension of the current research to incorporate an indirect GP – patient relationship. Fig 6.1, below, shows graphically an indirect relationship between GP 1 and Patient 2, GP 2 and Patient 3, GP 3 and Patient 1. It uses the concept of engaging GPs and non-regular patients. This is where additional benefits lie for GPs and patients from using an EHR system.

Fig 6.1 **Further Research**
Karolyn Spinks, University of Wollongong, 2004



Another suggestion of further research of EHRs in general practice could be the impact of EHRs and UPIs on the work practices of practice management staff, including receptionists and practice nurses working in GP's surgeries. This area was also outside the scope of the current research.

An opportunity for future research could be the degree of voluntary uptake of EHRs in general practice once EHRs are formally introduced by Health*Connect*, researching the intensity and extensiveness of voluntary use of EHRs. Similiarly, researching the degree that EHR software is reliable, the amount of "uptime", their ease of use, speed, accuracy, or researching the impact on GP work practices when an EHR system fails to work correctly during consultations. Furthermore, researching exactly how many

people have access to a patient's EHR may be another interesting research area – do practice nurses and/or practice management staff see a portion of the patient's EHR?

Many clinically important questions about use of EHRs in general practice remain partially or totally unanswered. For example, does the use of EHRs in general practice reduce the GP's awareness of the patient's clinical status? Would GPs be more concerned with simply reading the information in the patient's EHR rather than with the clinical implications of the actual information and how it affects the patient's health? Therefore, further empirical investigations along these lines may be beneficial.

The results of the current research were from a small group within the Illawarra. Consequently they may not reflect the situation of the broader GP community in the Illawarra or beyond. As EHRs become commonly used in general practice throughout Australia, quantitative research is recommended to test if EHRs do reduce the doctor's awareness of the patient's presence in the room – perhaps doctors will become less likely to interact with the patient, less likely to make eye contact, whereby the patient becomes less noticeable, less important or less entitled to receive healthcare for issues which are important to them.

Consideration must be given to EHRs and quality of care and patient health outcomes in general practice. Are EHRs helping to improve the quality of medical care in general practice? Are EHRs helping patients in matters of health and illness? These clinical questions are difficult questions to answer but are significant issues for future research.

A final suggestion for further research of EHRs in primary care relates to medical specialists rather than GPs. The EHR system could be evaluated in relation to medical specialist waiting times with the aim of assessing the degree of improved efficiency and quality of health care delivered by specialists, thereby assessing EHR performance against the original EHR implementation objectives. This idea is supported by NEHRT (2000 p 68, Appendix B p120) who states, "Monitoring of medical specialist waiting times could be part of the evaluation of EHR systems".

Bibliography

1. Akerman F. (1984). "Surgery Computer: A Quiet Revolution for General Practice." British Medical Journal **vol 288**.

2. American Psychiatric Association. (1999). "AMA Delegates Support APA Position Against Use of National Patient Identifier." Psychiatric news. [online] [cited 11 April 2001] Available WWW: <URL http://www.psych.org/pnews/index.cfm or http://apaweb.psych.org/pnews/index.html

3. Appavu S. (1997). Analysis of Unique Patient Identifier Options Final Report, prepared for United States Dept of Health and Human Services. [online] [cited 11 April 2001] Available WWW: <URL: http://ncvhs.hhs.gov/app0.htm or http://www.hipaanet.com/upin1.htm

4. Appavu S. (1999). "Unique Patient Identifiers-What Are The Options?" Journal of American Health Information Management Association. [online] [cited 15 April 2001] Available WWW: <URL: http://www.ahima.org/journal/features/feature.9910.2.html. (Note: no longer available to public through AHIMA web site. Accessible to AHIMA members via FORE Library: HIM Body of Knowledge)

5. Australian Medical Workforce Advisory Committee (2000). The general practice workforce in australia, Supply and Requirements 1999-2010. Sydney, AMWAC, NSW Dept of Health.

6. Bakker A. (1998). "Security in perspective; luxury or must." International Journal of Medical Informatics **49**: 31-37.

7. Ball M., Douglas J., (1992). "The Computer Based Patient Record." Informatics in Healthcare - Australia **1**(3): 15-18.

8. Barber B. (1998). "Patient data and security: an overview." International Journal of Medical Informatics **49**: 19-30.

9. Basden A., Clark. E. M. (1980). "Data Integrity in a General Practice Computer System (*CLINICS*)." International Journal Bio-Medical Computing **11**: 511-519.

10. Bauer M., Gaskell G., (2000). Qualitative Researching with Text, Image and Sound. London, Sage Publications Ltd.

11. Bennett B. (2001). "The development of e-health in Australia." Sydney Law Review **23**: 405- 421.

12. Blaxter L., Hughes C., Tight M., 1999 How to research, Open University Press, Buckingham, U.K.

13. Bomba D. (1999). Health Informatics - moving from technics and the fragmentation of knowledge to a socio-political understanding of design and diffusion of computerised health records among General Practitioners. PhD Dissertation, School of IT and Computer Science. Wollongong, University of Wollongong.

14. Bomba D., Fulcher. J., Dalley A., (2004). "Construction of a Diabetes Database and Pilot Evaluation of iKey Controlled GP-Patient Access." The Journal on Information Technology in Healthcare **vol 2**(5): 329-339.

15. Britt H., Miller. G., et al (2001). General Practice activity in Australia 2000 - 01, GP Statistics and Classification Unit: University of Sydney, Australian Institute of Health and Welfare.

16. Buckley P., Togno J., Hovel J., et al (1995). TeleHealth in Rural and Remote Australia: Report of the Project for Rural Health Communications and Information Technologies (PRHCIT), Australian Rural Health Research Institute, Monash University Dept of Medical Informatics, and Queensland University of Technology. [online] [cited 11 Nov 2003] Available WWW: <URL: http://www.med.monash.edu.au/mrh/resources/telehealthreport/tele16.htm#Heading20

17. Butler J., Calnan., M., (1987). Too Many Patients? A study of the economy of time and standards of care in general practice. Canterbury, Great Britain, Avebury, Gower Publishing Company Ltd.

18. Cacek J. (1994). A survey of the Attitudes of Australian General Practitioners to Computerisation of Medical Records. Dept of Community Medicine. Melbourne, Monash University, Australia.

19. Cavana R.Y., Delahaye. B. L., Sekaran U., (2001). Applied business research. Brisbane, John Wiley & Sons Australia, Ltd.

20. Chadwick D.W., Crook. P.J., Young A.J., et al (2000). "Using the internet to access confidential patient records: a case study." British Medical Journal **321**(7261): 612-614

21. Coiera E. (1996). "Clinical communication - a new informatics paradigm." Journal American Medical Informatics Association (Symposium Supplement - Proceedings 1996 AMIA Annual Fall Symposium): p 17-21

22. Coiera E. (1997). Guide To Medical Informatics, The Internet and Telemedicine. London, Chapman & Hall Medical, p1-338.

23. Commonwealth Dept of Health and Aged Care, (2001). The Australian Coordinated Care Trials, Reflections and Lessons. Canberra, Commonwealth Dept of Health and Aged Care: 149-154, Australia

24. Commonwealth Dept of Health and Aged Care (2001). The Australian Coordinated Care Trials: Summary of the Final Technical National Evaluation Report on the First Round of Trials. Canberra, Commonwealth Department of Health and Aged Care, Australia

25. Commonwealth Dept of Health and Aging. (2004). Broadband for Health, DHA, Australian Government. **2004**, [online] [cited 5 Oct 2004], Available WWW: URL: http://www.health.gov.au/ehealth/broadband/, or http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-ehealth-broadband-index.htm, or http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-mediarel-yr2004-ta-abb141.htm

26. Cooling N., Kidd M., Sloggett S., (1997). "Use of computers by general practitioners for patient education." Australian Family Physician **26**(1): 31-36.

27. Cornwall A. (2002). "Electronic Health Records: An International Perspective." Health Issues **no. 73**: p19-23.

28. Dalley A, Fulcher. J., Bomba D., Lynch K., Feltham P., (2005). "A Technological Model to Define Access to Electronic Clinical Records." IEEE Transactions on Information Technology in Biomedicine **vol 9**(2): 1-2.

29. Dalley A., Lynch. K., Feltham P., Fulcher J., Bomba D., (2006). "The use of smart tokens to permit the secure, remote access of electronic health records." International Journal Electronic Health **vol 2**(1): p1-11.

30. Davidson K., Holtz. D. (1998). Do Unique Identifiers Violate Patient Privacy? Physician's News Digest. [online] [cited 11 April 2001] Available WWW: URL: http://www.physiciansnews.com/law/1098davidson.html

31. Davidson V. (2004). What's New in Privacy? HISA & HIMAA Educational Meeting: The New Privacy Legislation & General Disposal Authority. Sydney, June.

32. Dickie J. (2004). Submission by Privacy NSW to the Australian Government Discussion Paper on Information Privacy and Employee Records. Sydney, Office of the NSW Privacy Commissioner, NSW Attorney General's Department. **2004**. [online] [cited 11 July 2004] Available WWW: URL: http://www.lawlink.nsw.gov.au/lawlink/privacynsw/ll_pnsw.nsf/vwFiles/sub_infoprivacy.pdf/$file/sub_infoprivacy.pdf#target='_blank'

33. e-MDs (2003). EMRs vs. Paper Records: An Electronic Medical Record Should Still be a Medical Record. [online] [cited 11 Feb 2004] Available WWW: URL: http://www.e-mds.com/emds/benefits/emr_comparison.html

34. Emery J., Walton R., Coulson, A., et al (1999). "Computer support for recording and interpreting family histories of breast and ovarian cancer in primary care (RAGs): qualitative evaluation with simulated patients." British Medical Journal **vol 319**(7201): 32-36.

35. Frean I. (2001). Impact of Use of Smart-Ids on General Practitioner-Patient Workflow Processes. in IDGP SPIRT Project Annual Progress Report 2001, Wollongong, Australia, University of Wollongong.

36. Fry J. (1983). Present State and Future Needs in General Practice, MTP Press Ltd, Lancaster, England.

37. Fischer S., Blonde. L. (1999). "Impact of an Electronic Medical Record on Diabetes Practice Workflow." Clinical Diabetes **v17,** (i2): p89. avail online http://web7.infotrac.galegroup.com.ezproxy.uow.edu.au:2048/itw/infomark/643/35/64775380w7/purl=rc1_EAIM_0_A54526464&dyn=3!xrn_1_0_A54526464?sw_aep=uow

38. Fulcher J. (2004). "The use of patient biometrics in accessing electronic health records." International Journal Healthcare Technology and Management **vol 6**(no 1): 20-30.

39. Gorman G. E., Clayton. P. (1997). Qualitative Research for the Information Professional: A Practical Handbook. London, Library Association Publishing.

40. General Practice Branch DHAC (2000). General Practice in Australia: 2000. Canberra, ACT.

41. Graziano A., Raulin M., 2004, Research Methods: A Process of Inquiry, Fifth Edition, Person Education Group, Boston, USA

42. Greatbatch D, Luff P., Heath C, Campion P, (1993). " Interpersonal communication and human-computer interaction: an examination of the use of computers in medical consultations." Interacting with computers **5**(2): 193-216.

43. Gritzalis D., Lambrinoudakis C., *A security architecture for interconnecting health information systems.* International Journal of Medical Informatics, 2004. **73**(3): p. 305-309

44. Hallit, G., Bomba, D. (2002). "Will the new Australian Privacy Law provide adequate protection?"" Australian Health Review **25**(3): 141-151.

45. Health*Connect* Program Office (2002). Draft Health*Connect* Business Architecture, version 0.7, Canberra, ACT, Australia, Australian Commonwealth Dept Health and Ageing.

46. Health*Connect* Program Office (2003). HealthConnect Interim Research Report Vol 1 Overview and Findings. Canberra, ACT., HealthConnect Program Office, Dept Health and Aging.

47. Health*Connect* Program Office (2003). Health*Connect* Interim Research Report Vol 2 Research Reports. Canberra, ACT, Dept of Health and Aging**,** report 5, p 1-30.

48. Health*Connect* Program Office (2003). Health*Connect* Interim Research Report Vol 3 Background Documents. Canberra, ACT, Dept of Health and Aging**:** part 3, p 1-82.

49. Health*Connect* Program Office. (2004). Health*Connect* Business Architecture Version 1.9, Canberra, ACT, Australia, Commonwealth Dept Health and Aging.

50. Health*Connect* Program Office (2004). Telephone Communication from Catchatoor H., Canberra, ACT, Australia, Evaluation, Integration and International Section, National e-health Systems Branch, Information and Communications Division, Australian Government Department Health and Aging, Dec 2004.

51. Health*Connect* Program Office (2005). About Health*Connect*, Dept of Health and Aging. Health*Connect* Website, [online] [cited 11 Nov 2005] Available WWW URL http://www.healthconnect.gov.au/about/index.htm, webpage last updated 8 November 2005

52. Heard S., Grivel. T., Schoeffel P., Doust J., et al (2000). The Benefits and Difficulties of Introducing a National Approach to Electronic Health Records in Australia, Report by Flinders University, Australia, to Electronic Health Records Taskforce.

53. HIC (2003). Frequently Asked Questions About HIC Online, HIC. [online] [cited 11 Feb 2004] Available WWW: URL: http://www.hic.gov.au/providers/online_initiatives/hic_online/faq.htm

54. Hovenga E., Kidd. M., Cesnik B., (1996). Health Informatics: an overview. Melbourne, Australia, Churchill Livingstone.

55. Illawarra Division of General Practice, (2001). GP Gateway Final Report. Wollongong, NSW, Illawarra Division of General Practice. [online] [cited 30 November 2003] Available WWW: URL: http://www.idgp.org.au/frames.asp?href=reports%2Findex%2Easp

56. Jovanovski O. (2002). An Evaluation of the Usage of the Smart Identification System by General Practitioners and Diabetes (Type 2) Patients in the Illawarra, honours thesis, School of IT and Computer Science, Faculty of Informatics. Wollongong, University of Wollongong**:** 110.

57. Kay S., Purves I. N., (1996). "Medical Records and Other Stories: A Narratological Framework." Methods of Information in Medicine **35**: 72-87.

58. Kindberg T., Bryan-Kinns N., Makwana R., (1999). Supporting the shared care of diabetic patients. Proceedings of the international ACM SIGGROUP conference on Supporting group work, Phoenix, Arizona, United States, ACM Press New York, NY, USA.

59. Lee J S., Tsaib C. T., Penc C.H., Lud H.C. (2003), A real time collaboration system for teleradiology consultation. International Journal of Medical Informatics 72, 73-79 (2003).

60. Leedy P. (1993). Practical research planning and design. New York, Macmillan Publishing Company.

61. Lenz R., Kuhn K. A., (2004). "Towards a continuous evolution and adaptation of information systems in healthcare." International Journal Medical Informatics **73**(1): 75-89.

62. Leung G.M., Yeung Y. T., Lai T.Y.Y., Johnston J.M., et al (2004). "Physicians' perceptions towards the impact of and willingness to pay for clinical computerization in Hong Kong." International Journal of Medical Informatics **73**(5): 403-414.

63. Liaw S., Chan. D. (1993). "MUFFIN: an approach to the computer-based patient record." Informatics in Healthcare - Australia **vol 2**(No 1): 27-35.

64. Little A.D. (1992). Telecommunications: Can it help solve America's health care problems? Cambridge, MA, USA, Little Publishers.

65. Lobach D.F., Hammond W. E. (1994). Development and evaluation of a computer-assisted management protocol (CAMP): Improved compliance with care guidelines for diabetes mellitus. 18th Annual Symposium on Computer Applications in Medical Care, Journal of the American Medical Informatics Association.

66. Martin J. (1995). The Great Transition - using the seven disciplines of enterprise engineering to align people, technology and strategy. New York, AMACON Books, American Management Association.

67. McAlpin I. (2001). Personal Communication with K. Spinks. Sydney, Australia.

68. Morse J., Richards L., (2002). Readme First for a User's Guide to Qualitative Methods. London, Sage Publications.

69. National Electronic Health Records Taskforce (2000). A Health Information Network for Australia. Canberra, Information & Research Branch of Commonwealth Dept of Health & Aged Care, Australia p XIII - 192.

70. National Health Information Management Advisory Council (1999). Health Online: A Health Information Action Plan for Australia. Canberra, Dept of Health & Aged Care.

71. National Health Information Management Advisory Council (2001). Health Online: A Health Information Action Plan for Australia. Canberra, Dept of Health & Aged Care.

72. National Health Privacy Working Group, (2002). National Health Privacy Code (Draft) Consultation Paper, Australian Dept of Health and Ageing. [online] [cited 18 Aug 2003] Available WWW: URL: http://www.health.gov.au/pubs/nhpcode.htm

73. National Health Strategy. (1992). The Future of General Practice. Issues paper; no. 3. Melbourne, National Health Strategy.

74. NSW Ministerial Advisory Committee on Privacy and Health Information (2000). Panacea or Placebo? Linked Electronic Records and Improvements in Health Outcomes**:** 1-61.

75. NSW Health (2003). Unique Patient Identifier Strategic Context. Powerpoint presentation, filename: UPI-NSW-Strategic-Context.1.0-DOH.ppt., slide 4, Sydney, Australia.

76. NSW Health Council (2000). Report of the NSW Health Council: A Better Health System for NSW. Sydney, NSW Health Council: pXI-104, [online] [cited 10 Nov 2005] Available WWW URL: http://www.health.nsw.gov.au/pubs/date/2000.html

77. Office of the Federal Privacy Commissioner (2000). "Guidelines on Privacy in the Private Health Sector." **part B, section 6,**: p 31-33. [online] [cited 26 Nov 2002] Available WWW URL: http://www.privacy.gov.au/health/index.html and www.privacy.gov.au/business/index.html,

78. Parasuraman R. (1996). Human Use and Abuse of Automation. Second Automation Technology And Human Performance Conference, Florida, USA, Lawrence Erlbaum Associates, NJ, USA.

79. Pendleton D., Schofield. T., Tate P., Havelock P., (1984). The Consultation - an approach to learning and teaching. Oxford, Oxford University Press.

80. RACGP (2002). Handbook For The Management Of Health Information In Private Medical Practice. **2005**. available www http://www.racgp.org.au/document.asp?id=6528 or http://www.racgp.org.au/downloads/pdf/20021014privacy.pdf accessed 19 Jan 2005

81. Ramsay J., Barabesi. A., Preece J., (1996). "Informal communication is about sharing objects and media." Interacting with Computers **8**(3): 277-283.

82. Rice R.E., (1992). "Task analyzability, use of new media, and effectiveness: a multi-site exploration of media richness." Organizational Science **3**: 475-500.

83. Richards B., Bolton. P., Veale B., Quinlan F., (1999). Information Technology in general practice, Commonwealth Dept of Health & Aged Care.

84. Sayer G., B., Horn F., Bhasale A., McGeechan K., et al, (2000). Measures of health and health care delivery in general practice in Australia, GP Statistics and Classification Unit: University of Sydney, Australian Institute of Health and Welfare.

85. Shanit D., Cheung. A., Greenbaum R.A., (1996). "Telecardiology: supporting the decision-making process in general practice." Journal Telemedicine and Telecare **2**: 7-13.

86. Shiffman R.N. (1994). Towards effective implementation of a pediatric asthma guideline: Integration of decision support and clinical workflow support. Proceedings of 18th Symposium on Computer Applications in Medical Care.

87. Slack W. (2001). Cybermedicine, How Computing Empowers Doctors and Patients for Better Health Care, Jossey-Bass, A Wiley Company, San Francisco, California.

88. Snooks (2002). Style Manual: for authors, editors and printers, John Wiley & Sons Australia, Ltd.

89. Spinks K, Cooper J, (2001) “Results of a Study of Acceptance of Unique Patient Identifiers in a General Practice Setting”, In *Proc.Health Informatics Conference (HIC 2001), Canberra, Australia,* July 29-31, 2001, Handbook of Abstracts (Eds) James P., Smith J., Smith L., ISBN 0 9585370 8 9 (Title of Abstract in Handbook: GP attitudes to and acceptance of a Smart IS using distributed patient information folders and UPIs)

90. Spinks K., Fulcher. J., Dalley A., (2001). Survey of GP Attitudes to Smartcards. *In Proc. 10th Health Informatics Association NSW Conference*, Hunter Valley, NSW, Australia, 17-18 February

91. Spinks K., Soar J., Cooper J., (2003). “Changes in GP Workflow Associated With E-consent and Access Control to Remote Patient Clinical Information”, In *Proc. Health Informatics Conference (HIC 2003)*, Sydney, Australia, Aug 10-12, 2003, Handbook of Abstracts (Eds) Coiera E., Simpson C.,ISBN #:0 9751013 0 7 (Title of Abstract in Handbook: What is the impact on GP workflow processes of Patient Identifiers/UPIs in primary care?

92. Stein D.L. (1997). "The electronic medical records: promises and threats." Web Journal; Web security: a matter of trust **vol 2**(issue 3).

93. Sykes J.B. (1976). The Concise Oxford Dictionary of Current English. Oxford, England, Oxford University Press.

94. Tange H.J. (1995). "The paper-based patient record: Is it really so bad?" Computer Methods and Programs in Biomedicine (48): 127-131.

95. Taylor R., McAvoy. B., O'Dowd T., (2003). General Practice Medicine. Great Britain, Churchill Livingstone,.

96. Thomas R.M. (2003). Blending Qualitative and Quantitative Research Methods in Theses and Dissertations. Thousand Oaks, California, USA, Corwin Press, Inc.

97. Tsumoto S., Hirano, S., Hanada, E. (2003). Internet-based Decision Support: Towards E-Hospital. Computer Software and Applications Conference, COMPSAC 2003, Dallas, Texas, USA.

98. Tufo H.M., Spiedel J.J., (1971). "Problems with Medical Records." Medical Care (9): 509-517.

99. United States Dept of Health and Human Services (1998). Unique Health Identifier for Individuals. A White Paper. [online] [cited 15 April 2001] Available WWW: URL: <http://www.epic.org/privacy/medical/hhs-id-798.html

100. Victorian Dept of Human Services (2001). The Victorian Ambulatory Care Sensitive Conditions Study: Preliminary Analyses. Melbourne, Vic DHS, Health Outcomes Section Development and Resources Branch Public Health Division. [online] [cited 2 April 2004] Available WWW: URL: http://www.dhs.vic.gov.au/phd/acsc/downloads/0104072.pdf

101. Weed L (1969). Medical Records, Medical Education, and Patient Care: The Problem-Oriented Record As a Basic Tool. Chicago.,IL, USA, Year Book Medical Publishers.

102. Wilson S., Chapman M., Nancarrow L., Collins J., (2001). "Macarthur model for ambulatory services." Australian Health Review **24**(2): 187-193.

103. Wooldridge M. (2000). Health Ministers Give Green Light to National Health Information Network. Canberra, ACT., Dept Health and Aged Care, [online] [cited date??] Available WWW. URL: http://www.health.gov.au/mediarel/yr2000/mw/mwhmc2005.htm And http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-mediarel-yr2000-mw-mwhmc2005.htm

104. Wyatt J. (1995). Evidence-based decision support - Is it feasible? Workshop on Decision support in primary and secondary care - priorities for implementation, NTRHA.

105. Yin R.K., (1994). Case Study Research: Design and Methods, Sage Publications, California, USA

Please see print copy for Appendices