Electronic Clinical Decision Support (eCDS) in Primary Health Care: A Multiple Case Study of Three New Zealand PHOs

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Dedication

In loving memory of my parents, Josey and James Albert Phillips.

Abstract

Health care providers internationally are facing challenges surrounding the delivery of high quality, cost effective services. The use of integrated electronic information systems is seen by many people working in the health sector as a way to address some of the associated issues. In New Zealand the primary health care sector has been restructured to follow a population based care model and provides services through not-for-profit Primary Health Organisations (PHOs). PHOs, together with their District Health Boards (DHBs), contributing service providers, and local communities, are responsible for the care of their enrolled populations. The Ministry of Health (MoH) is streamlining information sharing in this environment through improvements to computer based information systems (IS). By providing health professionals with improved access to required information within an appropriate time frame, services can be targeted efficiently and effectively and patient health outcomes potentially improved. However, the adoption of IS in health care has been slower than in other industries. Therefore, a thorough knowledge of health care professionals' attitudes to, and use of, available IS is currently needed to contribute to the development of appropriate systems.

This research employs a multiple case study strategy to establish the usage of IS by three New Zealand PHOs and their member primary health care providers (PHPs), with a focus on the role of IS in clinical decision support (CDS). A mixed method approach including semi-structured interviews and postal surveys was used in the study. Firstly, the research develops and applies a survey tool based on an adaptation of an existing framework, for the study of IT sophistication in the organisations. This provides the foundation for an in-depth study of the use of computerised CDS (eCDS) in the PHO environment. Secondly, a conceptual model of eCDS utilisation is presented, illustrating the variation of eCDS use by member general practitioner (GP) practices within individual organisations. Thirdly, five areas of importance for improving eCDS utilisation within PHO's are identified, contributing information of use to organisations, practitioners, planners, and systems developers. Lastly, the research provides a structure for the study of the domain of eCDS in PHOs by presenting a research approach and information specific for the area.

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Publications

Results from the pilot study were presented by the author of this thesis at three conferences and resulted in the following publications, the work being that of this author, with supervisory and editorial input provided by Drs. Whiddett and Hunter:

Refereed journal publications:

Engelbrecht, J., Whiddett, R., & Hunter, I. (2006). The use of information systems for clinical decision support by primary health care practices in a medium sized PHO. *Health Care and Informatics Review Online*^{TM}. September 1, 2006. Retrieved from http://www.hinz.org.nz/journal/2006/9

Engelbrecht, J., Hunter, I., & Whiddett, R. (2007a). Further evidence of how technology availability doesn't guarantee usage. *Health Care and Informatics Review Online*^{TM}, October 31, 2007. Retrieved from http://www.hinz.org.nz/journal/2007/10

Conference proceedings:

Engelbrecht, J., Whiddett, R. & Hunter, I. (2006). The use of IS for clinical decision support by primary health care practices in a medium sized PHO: Results from a pilot case study. In *Conference Proceedings, Health Informatics New Zealand, Primary Care and Beyond: Building the e-Bridge to Integrated Care, Aotea Centre, Auckland, New Zealand, 9-11 August 2006*. HINZ, New Zealand.

Engelbrecht, J, Hunter I, & Whiddett R. (2007). Further evidence of how technology availability doesn't guarantee usage. In C. Peck & J. Warren (Eds.) *Proceedings - HINZ 6th Annual Forum and Exhibition, Rotorua, 29-31 October 2007.* Health Informatics New Zealand.

Engelbrecht, J., Hunter, I. & Whiddett, R. (2007b). Information technology for clinical decision support in primary health care practices. In Proceedings CD, *Medinfo 2007, 12th World Congress on Health (Medical) Informatics, Brisbane Convention Centre, Brisbane, Australia, 20-24 August 2007*. (Poster paper)

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Glossary of acronyms

AI/ES	Artificial Intelligence/Expert Systems
CDM	Clinical Decision Making
CDS	Clinical Decision Support
CEO	Chief Executive Officer
CIS	Clinical Information Systems
CPOE	Computerised Physician/Provider Order Entry
CREC	Central Regional Ethics Committee
DHB	District Health Board
DHBNZ	District Health Boards New Zealand
DSS	Decision Support System
eCDS	Electronic/Computerised Clinical Decision Support
EMR	Electronic Medical Record
FTE	Full-Time Equivalent
GP	General Practitioner
HIS	Health Information Systems
HIT	Health Care Information Technology
IPA	Independent Practitioner Association
IS	Computer Based Information Systems*
IT	Information Technology*
IT/S	Information Technology/Systems*
MDO	Māori Development Organisation
MHEC	Massey Human Ethics Committee
MIS	Management Information Systems
MoH	Ministry of Health
MSO	Management Service Organisation
NGO	Non-Government Organisation
NHI	National Health Index
PHARMAC	Pharmaceutical Management Agency of New Zealand
PHO	Primary Health Organisation
PHO-MS	Primary Health Organisation Management Service
PHP	Primary Health Care Provider
PMS	Practice Management System
RNZCGP	Royal New Zealand College of General Practitioners
TPS	Transaction Processing Systems
VPN	Virtual Private Network

* Within the literature there is a great deal of overlap in the use of the terms IS, IT and IT/S. This thesis will use the term IS to embrace the use of systems and their supporting technologies, but when discussing the work of others it will follow the usage of the original author.

1 Introduction

1.1 Topic area and research questions

There are government initiatives both within New Zealand and overseas promoting the establishment of integrated health care systems (WAVE Advisory Board [WAVE], 2001). With the implementation of its Primary Health Care Strategy, New Zealand is moving closer to this situation (King, 2001b; WAVE, 2001). Since 2001 New Zealand's primary health care sector has undergone restructuring to a population based care model provided through not-for-profit Primary Health Organisations (PHOs), with a team based multidisciplinary approach to the provision of health services (King, 2001b). The Ministry of Health (MoH) funds the primary health care sector through 21 District Health Boards (DHBs) which are responsible for PHOs in their area. There are currently 81 PHOs which, together with their DHBs and local communities are responsible for the care of their patient populations. The sizes of the enrolled populations of individual PHOs vary from 3,000 to 350,000. PHOs include a board of directors, a management service organisation (PHO-MS), and a group of providers which is most commonly made up of general practitioner (GP) practices. Their boards are composed of health care professionals, including GPs, nurses, pharmacists, Māori and Pacific Island providers, and community representatives (King, 2001b). They vary in legal form and can be charitable trusts, non-profit companies, or incorporated societies (MoH, 2007a).

Against this background of health care reform there are escalating staffing problems in New Zealand's primary care sector. Many GPs are leaving or retiring from practice and replacements are often difficult to find (Royal New Zealand College of General Practitioners [RNZCGP], 2005; 2006). With the current explosion of information and the adoption of evidence-based medicine, health practitioners are finding themselves suffering from information overload (Ely et al., 2002; Hunter 1997; WAVE, 2001). Additionally, a New Zealand report has suggested that increased paperwork associated with PHO requirements has contributed to the burden of GPs (RNZCGP, 2006).

PHOs operate extensive budgets and need to share information with their contributing primary health care providers (PHPs), and both parties will benefit from having well integrated systems. Also, during consultations GPs need to be able to find answers to their queries rapidly or questions remain unanswered (Ely et al., 1999; Smith, 1996). Therefore, providing health professionals with improved access to required information, within an appropriate time frame, could potentially improve patient health outcomes. This could partly be achieved by better utilisation of clinical decision support (CDS) technologies. Within the PHO structure these technologies would support clinical decision making (CDM) at both the population-based PHO level and the patient-based PHP level. This situation prompted the question that formed the focus of this study:

‘What scope is there to improve the use of IS for the support of clinical (population-based and patient-based) decision making by health care professionals working in the PHO environment?’

The need for a study such as this is fourfold. Firstly, the subject of computerised CDS (eCDS) in primary health care is a subject of interest to health care providers, both nationally and internationally and studies contributing to the knowledge base in the area are needed. Electronic decision support has been defined as

> “Access to knowledge stored electronically to aid patients, carers, and service providers in making decisions on health care” (National Electronic Decision Support Taskforce [NEDST], 2003, p. 20)

and applied to CDS in particular. The term eCDS has been chosen to describe the subject area of this thesis which focuses on the broad range of electronic technologies providing CDS in primary health care. Secondly, the recently deployed PHO organisational health care structure is still evolving, and the use of CDS technologies are seen as a way of facilitating some of the objectives of the MoH. Therefore, an investigation and analysis of the current use of such technologies in New Zealand is timely. Thirdly, health care in New Zealand is currently facing difficulties in recruiting and retaining doctors. In primary care, the situation regarding the falling number of GPs has recently been described as a crisis, and improvements to the support of practitioners in their work are needed. It is hoped that this study will illuminate how technology could contribute to that support, and highlight improvements which might be made. Lastly, little research has been done on the use of eCDS in the PHO environment in New Zealand and this study provides a structure for the study of the research domain.

The focal question ‘What scope is there to improve the use of IS for the support of clinical (population-based and patient-based) decision making by health care professionals working in the PHO environment?’ was developed into five research questions upon which an interview schedule and postal questionnaire were based:

- How are IS used in the support of clinical decision making by PHO professionals?

- How do IS used for clinical decision support meet PHO professionals information /reporting needs?

- What are the barriers to/what factors influence the use of IS for clinical decision support by PHO professionals?

- What IS useful for decision support are available but not used in the PHO environment?

- How can the use of IS for the support of clinical decision making in PHOs be improved?

The study area was chosen because of its importance, the researcher's personal interest in the subject, and her experience and contacts made during a previous study in the primary health care environment. The research setting of this thesis was New Zealand primary health care, more specifically, in three PHOs. Case study research was carried out in each PHO, where management services and GP practice personnel were interviewed about their currently available IS and how they utilise them for CDS. Through these interviews the opinions of the participants were sought, a postal survey partly based on an existing framework was developed and sent to the remaining GP practices, and documents were collected where available.

1.2 Thesis Summary

1.2.1 Aims of thesis

The thesis aims to identify ways to improve the integration of information needed for CDM in the PHO environment by analysing and modelling the use of eCDS at the both the PHO-MS and PHP levels. This would enable future development efforts to be focused in certain areas leading to the improved use of eCDS, better information sharing, and hence facilitate decision making at both the PHO-MS and individual PHP levels. The research therefore aims to answer the set of questions listed in Section 1.1.

1.2.2 Thesis objectives

The objectives developed in order to fulfil the aim of the research were as follows:

- Use a case study strategy to establish the current usage of IS within PHOs and their member PHPs,
- identify gaps in the levels of IS support, and disparities in current IS provision/use for CDS, in PHOs,
- develop a model of IS support for clinical decision making in the PHO environment,
- identify ways that the use of IS can be improved to enhance clinical decision making processes in PHOs.

In order to carry out the research objectives it was necessary to establish the existing IS support at the both the PHO-MS and PHP levels, as population-based and individual patient-based care require different support for their various activities. As all PHP practices in the contributing PHOs were GP practices they will be referred to as the latter, or simply as practices, in the subsequent text. A suitable framework which had been developed for use in secondary care was chosen and adapted as the basis for the study of the existing IS. Through face-to-face interviews with health professionals, the framework was applied in the New Zealand primary health care environment and a questionnaire with contents of specific relevance to GP practices was developed. The use of the available IS by health professionals, specifically for CDS, was also determined from the interviews, leading to the development of a conceptual model of eCDS utilisation by PHO-MS and member GP practices. Qualitative analysis of the interview data also led to the identification of five areas important for eCDS improvement in the PHO environment.

1.2.3 Research design

A literature review of the study area was conducted, the research questions defined, and case study strategy chosen for the research. Consultation with appropriate parties was entered into, and Ethics Committee approval for the study was obtained. According to Ying (2003) case studies can either be explanatory, descriptive or exploratory. This study was predominantly exploratory and descriptive in nature. A multiple case study was employed, consisting of a pilot and two additional case studies, using both qualitative and quantitative methods. The PHO-MS and three GP practices were included in the study for each PHO. A number of informants, totalling 41 in all, were interviewed with semi-structured, face-to-face interviews of approximately one hour each, providing the qualitative component of the study. Written notes were taken during the interviews which were tape recorded where possible. A further source of information, where available, was comprised of documentation provided by the PHOs and practices. Interview information, together with a theoretical framework derived from the literature review material, was used to develop a questionnaire survey tool. Quantitative information was collected by sending the postal questionnaire to all remaining GP practices in each case study PHO. The choice of a multi-method investigation for each PHO in the multi-case study was chosen to provide triangulation of evidence, where present, and provide strength to the results (Yin, 2003). After transcription of the interviews, a database of case study data was constructed using QSR's NVIVO 7 software, questionnaire results were entered into MS Excel, and the data analysed.

1.2.4 Results and contributions of the thesis

This research developed and tested a framework and survey tool for the study of information technology (IT) sophistication in New Zealand PHOs. A postal survey was developed for use at the GP practice level, to collect information on the types and amount of usage of technologies present, the activities/processes which they support, and the levels of systems integration found within practices of medium sized PHOs. The approach could be used for the development and application of a similar survey tool for use at the PHO level, encompassing all functional groups. Qualitative techniques were used in the development of the GP practice level survey tool, and to collect information also based on the framework from the case study management organisations. Qualitative techniques were also used to collect information on the focus the research: The use of IS in the support of CDM throughout the PHOs studied.

The thesis provides detailed information derived from interviews and surveys on the use of eCDS and issues surrounding it, in the study organisations. Although New Zealand's primary care is well equipped with IS, the utilisation of eCDS varies within organisations. The research presents a conceptual model of eCDS utilisation by GP practices, which illustrates how practices within individual PHOs vary in their utilisation of eCDS. The information provided by this work can be used by organisations, practitioners, planners and systems developers, to inform improvements in their current usage of available technologies for CDS and their systems development efforts. It also contributes to the pool of knowledge on eCDS for researchers in the field.

The research shows that, with increased data handling requirements necessitated under the PHO system, new systems are being implemented at a rapid rate. By answering a set of research questions this research provides knowledge of the issues experienced within PHOs surrounding the fast paced organisational and IS changes, focusing on eCDS. It then identifies five key areas of importance for the improvement of eCDS within PHOs: User support; systems' improvements; systems' integration; equalising organisational systems; and privacy of information, and details specific issues in each area. The research also contributes structure to the study of the primary health care eCDS domain.

IT sophistication has been studied in secondary health care but had yet to be studied in the primary health care environment until the current study was undertaken. Similarly, the adoption of computerised CDS technologies had been studied, including in primary care, but little work had been done from the perspective of an organisation, such as a PHO, with a focus on a range of technologies.

In conclusion, this thesis contributes to the research environment by

- providing a framework and survey tool for studying IT sophistication in primary health care and determining the IT sophistication in medium sized New Zealand PHOs;
- providing a foundation for the in-depth study of eCDS in the PHO environment;
- developing a conceptual model of eCDS utilisation in the study organisations;
- identifying barriers to the improved use of existing or new computer systems in CDS;
- describing five main areas where improvements to eCDS in PHOs could be made, and
- providing a structure for the study of the eCDS domain which could be useful to researchers working in other environments.

The objectives of this study were fulfilled and the aim of finding answers to the research questions was achieved. The initial question 'What scope is there to improve the use of IS for the support of clinical (population-based and patient-based) decision making by health care professionals working in the PHO environment?' was answered by addressing the five research questions developed during the study. The study resulted in a model of eCDS utilisation in New Zealand PHOs (Figure 7.1) and the description of five major areas influencing improvements in eCDS, thus contributing knowledge to the research area.

1.2.5 Report Structure

This thesis is comprised of eight chapters, plus references and appendices. After the overview of the thesis provided in this first chapter, the second chapter presents a review that draws on literature from the field of study and is divided into three main sections: The research context, international health care information technology (HIT) research, and New Zealand HIT research. Chapter 3 describes the evolution of theory during the research. It re-iterates the research questions, and explains the development of the framework, interview schedule and questionnaire, and introduces model building. This is followed by Chapter 4 which describes the research design and the reasons for choices made. It begins with an explanation of the perspectives underpinning the study before introducing the case study design, the planning and consultation processes undertaken, the preparation for data collection, and the process of gaining ethical approval for the study. Chapter 5 addresses data collection and introduces the study organisations, explains how interviews and the postal survey were arranged and carried out, and outlines the approach to analysis. This is followed by data analysis and the presentation of findings in Chapter 6. The data analysis chapter is presented in three parts: Firstly, a brief section on the pilot study, followed by sections on IT sophistication, and lastly eCDS. A discussion of the results in Chapter 7 contains four foci: IT sophistication, eCDS, the introduction of the eCDS Utilisation Model, and research quality. Chapter 8 then presents the conclusions and recommendations of the study. Here the research questions are answered, the chapter reviews the major themes emerging from the investigation, including five main areas of importance for eCDS utilisation, and suggestions for future strategy and research are made.

2 Literature Review

2.1 Introduction to the literature review

This chapter explores the New Zealand primary health care information environment, international HIT research, and New Zealand health care informatics. The literature review fulfils the first of Bourner's (1996) four steps to successful research, 'reviewing the field' which consists of studying the current thinking in a research area and identifying gaps in the knowledge which need to be researched further (ibid.). The topics included in the review have been chosen to give both a background to the study area, and an overview of the current research in the field. This is important in gaining information on the subject, focusing the research and avoiding the possibility of repeating work which has already been done (ibid.).

Use was made of the facilities provided by the Department of Information Systems, the Department of Management, and the library at Massey University, which included access to the library's collection of books, journals, theses and on-line resources. Computer science and information systems, and medical and health science article databases were accessed including: ACM digital library; Web of Science; IEEE Xplore; Medline; Science Direct; and PubMed. A search of information available on the Internet was also conducted using, for example, Google Scholar, and information was requested from other libraries, government agencies and industry. Search terms used were various combinations of words including information, technology, systems, health, care, clinical, decision, support, model, adoption, diffusion, maturity, sophistication, organisation, and readiness, and utilised Boolean operators were utilised as necessary.

In order to gain an understanding of the literature relevant to the research field a Venn diagram (Figure 2.1) was constructed and the following research topics identified for study:

1. New Zealand health care: Organisational structures/PHOs, and health professionals' information needs
2. Trends in health informatics/eCDS: Towards the use of eCDS
3. Technology adoption and IS status: Background theory
4. International research on health care technology adoption, IS status and eCDS
5. New Zealand health informatics and eCDS

6. New Zealand research on health care technology adoption and IS status
7. IT sophistication and eCDS adoption in New Zealand PHOs

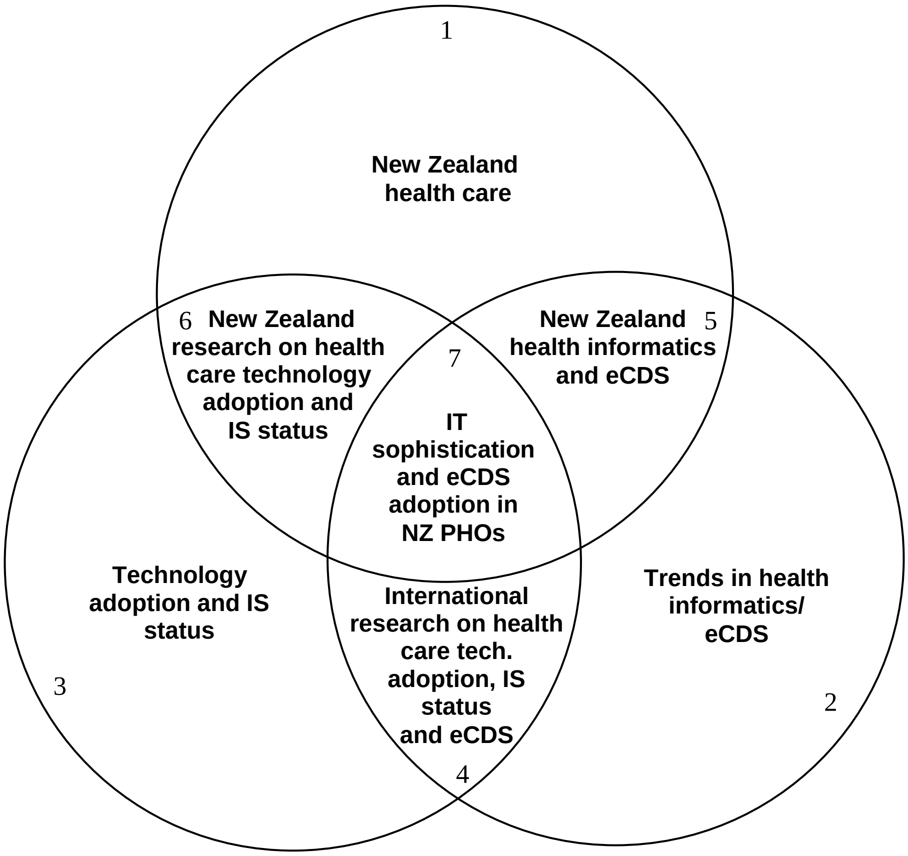

Figure 2.1: A Venn diagram showing the relationships between the literature review components

The seven research topics, illustrated in Figure. 2.1, are discussed in three sections as follows:

2.2 Research context: ‘New Zealand health care’; ‘Trends in health informatics/eCDS’, and ‘Technology adoption and IS status’ (Topics 1, 2 and 3).

2.3 International HIT research: ‘International research on health care technology adoption, IS status and eCDS’ (Topic 4).

2.4 New Zealand HIT research: ‘New Zealand health informatics and eCDS’, ‘New Zealand research on health care technology adoption and IS status’, and the thesis area: ‘IT sophistication and eCDS in New Zealand PHOs’ (Topics 5, 6 and 7).

2.2 Research Context

This research was conducted in the primary health care sector of the New Zealand health system. The subject area is health informatics with a particular focus on decision support technologies used in primary health care in the support of CDM by health care professionals.

Information systems literature, including that on technology adoption and IS status, was the main focus of the review. Outlines of the three context areas; 'New Zealand health care'; 'Trends in health informatics and eCDS', and 'Technology adoption and IS status' (Topics 1, 2 and 3), are provided in this section of the literature review.

2.2.1 New Zealand health care

New Zealand has a health and disability system which is mostly funded by the government from taxation, but also receives a proportion of its funding through government agencies and organisations such as the Accident Compensation Corporation (ACC), local government and private sources, including private insurance (Ministry of Health [MoH], 2008a). The MoH retains funding to provide centralised services in the areas of public health and disability support, but approximately 75% of the funding is devolved to DHBs which use it to organise and purchase services for their local populations (ibid.). These services include primary, secondary and tertiary care, public health services, and services provided by non-government health providers (NGOs) such as Māori and Pacific providers (ibid.). Each DHB funds a number of PHOs which are networks of primary care providers and include most GP practices.

The following definitions are provided as they clarify terms used in the discussion of New Zealand health care:-

Primary health care:

> Primary health care relates to the professional health care received in the community, usually from your GP or practice nurse. Primary health care covers a broad range of health and preventative services, including health education, counselling, disease prevention and screening. (Ministry of Health [MoH], 2007c, para. 1)

Primary Health Organisation (PHO):

> PHOs are the local structures for delivering and co-ordinating primary health care services. PHOs bring together doctors, nurses and other health professionals (such as Māori health workers, health promotion workers, dieticians, pharmacists, physiotherapists, psychologists and midwives) in the

> community to serve the needs of their enrolled populations. (MoH, 2007d, para. 1)

General Practitioner (GP):

> A general practitioner is an appropriately qualified medical graduate who has particular knowledge and skills to provide personal, family, whanau and community-oriented, comprehensive primary care. A GPs care continues over time, is anticipatory as well as responsive, and is not limited by the age, sex, race, religion, or social circumstances of patients, nor by their physical or mental states. (Royal New Zealand College of General practitioners [RNZCGP], 2008, para. 1)

The information environment:

> …the collective information capability (people, processes, and technologies) used by all people engaged in the health system to make decisions and act effectively to support the health and wellbeing of themselves, others, and communities. (MoH, 2007e, p. 5)

Health care systems:

> …healthcare systems are open systems influenced by a variety of social, economic, and political factors and by the physical environment within which they function. (Austin & Boxerman, 2003, p. 23)

New Zealand has experienced a series of health sector organisation reforms in the recent past. Since the publication of the government's Primary Health Care Strategy (King, 2001b), New Zealand's primary health care sector has undergone its most recent restructuring, to a population based care model provided through not-for-profit PHOs of varying structures. They include a board of directors, a management service organisation, and a group of providers which is most commonly made up of GP practices. PHO boards are composed of health care professionals, including GPs, nurses, pharmacists, Māori and Pacific Island providers, and community representatives (ibid.). They vary in legal form and can be charitable trusts, non-profit companies, or incorporated societies, and include a wide range of sizes (MoH, 2007a). The new strategy provides for a team based multidisciplinary approach to the provision of health services and new ways of collaborating are being developed (King, 2001b). The MoH funds the primary health care sector via 21 DHBs which, in turn, are responsible for PHOs in their area. The first PHOs were established in July 2002, and there are currently 81 (MoH, 2007b). Together with their DHBs and local communities, they are responsible for the care of their enrolled populations which vary from approximately 3,000 to 350,000 in size. PHO membership now accounts for approximately 3.9 million New Zealanders (ibid.).

Against this background of health care reform there are escalating staffing problems at the primary care ‘coal-face’. Many GPs are leaving or retiring from practice and replacements are often difficult to find (RNZCGP, 2005, 2006) with rural areas being particularly badly affected. Information overload has been recognised as a problem faced by GPs in their working environment (Ely et al., 2002; Hunter, 1997; WAVE, 2001) and studies have shown that doctors need to be able to find answers to their queries rapidly or questions can remain unanswered (Ely et al., 1999; Smith, 1996). Research by Alper et al., (2004), estimated the time needed for the review of literature relevant to primary health care by physicians trained in medical epidemiology. The authors included 341 journals in their study and determined that it would take the physicians 627.5 hours per month to evaluate the appropriate articles identified (ibid.). Also, a New Zealand report has suggested that increased paperwork associated with PHO requirements has contributed to the burden of GPs (RNZCGP, 2006). The use of IS has been suggested by many workers as a way of addressing some of these problems and reducing the burdens faced by health professionals in their every-day work, for example, by providing access to timely and accurate information (Barnett, Barry, Robb-Nicholson, & Morgan 2004; Hanka, O'Brien, Heathfield, & Buchan, 1999; Health Information Strategy Steering Committee [HISSC], 2005; Smith, 1996; WAVE, 2001).

2.2.2 Trends in health informatics/eCDS

This section briefly introduces the area of health informatics, and provides the context of CDS technologies which are a focus of this research. According to the British Medical Informatics Society (BMIS) the terms ‘medical informatics’ and ‘health informatics’ can be described as

> …the understanding, skills and tools that enable the sharing and use of information to deliver healthcare and promote health. 'Health informatics' is now tending to replace the previously commoner term 'medical informatics', reflecting a widespread concern to define an information agenda for health services which recognises the role of citizens as agents in their own care, as well as the major information-handling roles of the non-medical healthcare professions. ...the application of information and communication technologies to healthcare - the place where health, information and computer sciences, psychology, epidemiology and engineering intersect. (BMIS, 2004, p. 1)

Austin and Boxerman state that Clinical Information Systems (CIS)

> …support patient care and provide information for use in strategic planning and management. Applications include computerised patient record systems; clinical department systems such as pharmacy, laboratory, and radiology; automated medical instrumentation; clinical decision-support systems (computer-aided diagnosis and treatment planning); and information systems that support clinical research and education. (Austin & Boxerman, 2003, p. 11)

They state that the concept of decision support

> …can be viewed as an *approach* to problem solving that is based on the use of data. Many strategies might be considered for the actual *implementation* of this approach, ranging from a totally manual strategy to one that is totally automated. (Austin & Boxerman, 2003, p. 227)

Alter (2004) provided arguments for the use of a broad definition of decision support, as opposed to focusing on that provided by decision support systems (DSS), and included non-electronic factors of decision support in its definition. In this wider sense, CDS has been described by the Healthcare Information and Management Systems Society (HIMSS) as follows:

> Clinical Decision Support (CDS) is defined broadly as a clinical system, application or process that helps health professionals make clinical decisions to enhance patient care. Clinical knowledge of interest could range from simple facts and relationships to best practices for managing patients with specific disease states, new medical knowledge from clinical research and other types of information. (HIMSS, 2008, para. 1)

A broad definition of CDS has been chosen for the focus of this research, but one that concentrates on a range of electronic sources and originated in a report prepared for Australia's health sector which defined electronic decision support as "Access to knowledge stored electronically to aid patients, carers, and service providers in making decisions on health care" (NEDST, 2003, p. 20), and applied the definition to CDS in particular. Reflecting on this definition, the term eCDS provides an apt description of the subject area of this thesis which focuses on the broad range of electronic technologies providing CDS in primary health care.

The use of computerised information technologies in health care began in the early 1960's with the introduction of administrative systems in secondary health care institutions (Anderson, 1997; Austin & Boxerman, 2003) and early enthusiasm at the prospect of CIS implementations soon to follow. However, it has long since been observed that the general uptake of IT in health care has lagged behind that in other types of organisations such as those in the business world (Audet et al., 2004; Bower, 2005; England & Stewart, 2003; Fonkych & Taylor, 2006). CDS in particular had originally been thought of as an area where systems would be adopted rapidly, but developments have proven otherwise (Anderson, 1997; Gillies, 2005; Kaplan, 2001a, 2001b). In their report for RAND Health, Fonkych and Taylor stated that:

> Innovations in information technology (IT) have improved efficiency and quality in many industries. Healthcare has not been one of them. Although some administrative IT systems, such as those for billing, scheduling and inventory management, are already in place in the healthcare industry, little adoption of clinical IT, such as Electronic Medical Record Systems (EMR-S) and Clinical Decision Support tools, has occurred. (Fonkych & Taylor, 2005, p. xi)

Governments and health care providers internationally have targeted greater use of HIT, including electronic medical record (EMR) and CDS technologies as a way of improving certain current health care challenges (Bush, 2004; Department of Health, 2002; Institute of Medicine, 2001; Mount, Kelman, Smith, & Douglas, 2000; National Health Information Management Advisory Council [NHIMAC], 2001; Paré & Sicotte, 2001; Wave, 2001). HIT solutions have the potential to address health care issues surrounding cost containment, quality improvement, consumer empowerment, reduction of medical errors, the use of evidence-based medicine, and privacy and confidentiality (Austin & Boxerman, 2003; Cushman, 1997; Gillies, 2005; Sittig, Krall, Dykstra, Russell, & Chin, 2006). National strategies for specifically improving eCDS have been suggested (NEDST, 2003; Osheroff et al., 2007). However, issues still remain to be addressed concerning the failure of HIT implementations (Heeks, 2006), and further work is indicated in establishing patient outcomes as illustrated by a systematic review of primary care computing (Mitchell & Sullivan, 2001).

2.2.3 Technology adoption and IS status

Taxonomies of IS research areas

A number of inter-related and overlapping constructs of interest have been encountered during this research, including IT maturity, IT sophistication, IT munificence, and organisational maturity/readiness. Clarifying the position of a research domain amongst associated or closely related areas assists researchers to assess the efforts of others which could contribute to their field of study, or identify gaps in knowledge or topics needing further exploration (Benbasat & Zmud, 1999; Larsen, 2003). The following research helped to clarify the relationships of some of the research areas encountered during the literature review. Larsen's (2003) paper devoted to the creation of a taxonomy of the antecedents of IS success concentrated on variable analysis research as a starting point, but acknowledged that the taxonomy could be extended with the inclusion of a broader range of studies. The paper cited the work of Kwon and Zmud (1987) who reviewed empirical and non-empirical studies of organisational innovation and IS implementation to arrive at a set of forces for success, comprised of a total of 22 attributes, and their associations with stages of the innovation process. The main categories identified were individual, structural, technological, task-related, and environmental factors (Kwon & Zmud, 1987). Larsen's (2003) study resulted in 12 general categories of concepts being identified, comprising 83 focal concepts, with research in each being examined. The taxonomy is useful for guiding researchers in the contexts of their research interests and highlighting areas needing further attention. The IT/IS/organisational maturity considerations, of interest in the current study, are categorised under the heading of 'IS Maturity' (Category 5) and include concepts of IT maturity and project development strategy described as "…the extent to which the organisation has a "historical" infrastructure indicative of a technological-savvy organisation and similarly mature project development strategies" (ibid., p. 184). Little research was found to be evident in the area, which included related concepts, including complexity of IT structure, evolution level of IS, IT infrastructure, IT sophistication and organisational maturity. The category of 'MIS Department' (Category 11) included the concept of MIS department maturity, and related ones such as IS department maturity, IS maturity and IS sophistication. The two categories were closely associated with both being included in two of five meta-categories, of 'IS expertise related' and 'Organisation related', described in the paper (ibid.). The study included research reported before the end of 1999 (ibid.), since which the previously little studied area of IT sophistication has seen some research activity. The concept of IT sophistication is discussed further in Sections 2.3 and 2.4 as it was chosen to provide the basis for part of the current research. Research areas associated with IT sophistication are described in the passages which follow.

Diffusion of innovation

Everett Rogers studied the diffusion of innovation over a long career and was undoubtedly highly influential in the subject area. His work in sociology, began in the 1950's with the study of the diffusion of agricultural innovations in rural Iowa, which laid the foundation for the publication of the first edition of his book 'Diffusion of Innovations' (Rogers, 1962), and a vast array of studies by himself, co-workers and other researchers, including those working in other disciplines. Rogers (2003) describes the main nine academic disciplines or sub-disciplines of the diffusion research traditions, including marketing and management, and communications, which include studies of IT. Diffusion studies have shown that the adoption of innovations in a wide variety of situations proceeds according to the innovativeness characteristics of individuals, categorised as innovators, early adopters, early majority, late majority, and laggards (Rogers, 2003, p. 281). The diffusion of an innovation follows an 'S curve' pathway whereby a lead phase involving a low percentage of early adopters is followed by a period of rapid adoption by many others, finally slowing once more with the gradual entry involvement of late adopters (Rogers, 2003).

Technology acceptance models

Research by Rogers, on the Innovation Diffusion Theory and the Innovation Decision Process (Rogers, 2003), provided the basis for a range of models of technology adoption including Davis's Technology Acceptance Model (TAM), (Davis 1986, 1989; Davis, Bagozzi, & Warshaw, 1989) and subsequent models such as the Theory of Trying (Bagozzi, Davis & Warshaw, 1992), TAM 2 (Venkatesh & Davis, 2000), and the unified theory (UTAUT), (Venkatesh, Morris, Davis, & Davis, 2003). The TAM model (Davis, 1986, 1989; Davis et al., 1989), in addition to having roots in diffusion theory, was also partly derived from the social psychology theories of Ajzen and Fishbein on the Theory of Reasoned Action (TRA), (Ajzen & Fishbein, 1980) and Ajzen's Theory of Planned Behaviour (TPB), (Ajzen, 1985).

With the proliferation of adoption studies came a movement to compare and refine various models, with a unified theory being published from a study of eight models of technology acceptance (Venkatesh et al., 2003). The Unified Theory of Acceptance and Use of Technology Model (UTAUT), (Venkatesh et al., 2003), included aspects of the Innovation Diffusion Theory (Moore & Benbasat, 1991; Rogers, 2003), the TPB (Ajzen, 1985), the TRA (Ajzen & Fishbein, 1980), the TAM model (Davis, 1986, 1989; Davis et al., 1989), the Motivational Model (Davis, Bagozzi, & Warshaw, 1992; Venkatesh & Speier, 1999), the model of PC Utilization (Thompson, Higgins, & Howell, 1991), Social Cognitive Theory (Compeau & Higgins, 1995), and a model combining TAM and TPB (Taylor & Todd, 1995). These models primarily concentrate on adoption of innovations by the individual rather than adoption at the organisational level, and focus on the person's intentions to use, and/or their usage of new technologies. The UTAUT model presents performance expectancy, effort expectancy, and social influence, as direct determinants of a person's intention to use, for example a new IS, with their behavioural intention and facilitating conditions as direct determinants of their usage behaviour. Voluntariness, age, gender and experience are included in the model as moderating influences (Venkatesh et al., 2003). Venkatesh et al. (2003), describe their model as contributing to and unifying research on the many explanatory models of acceptance by the individual.

As mentioned above, much adoption of innovation research has focused on aspects of individual behaviour towards a particular innovation. Therefore, a natural progression in the area was to focus on how complex organisations progress with innovation, for example in the adoption of new work processes or technologies, or the development of new products. Van de Ven, Polley, Garud, and Venkataraman (1999) pursued this research over a seventeen year period, via longitudinal studies in Minnesotan companies including 3M, Millipore and Qnetics. The case studies alone took ten years to complete, having input from over thirty researchers and students. The researchers found that innovation in these complex situations took the form of a cyclic process of divergent and convergent behaviours which either resulted in adoption or rejection of the innovation in question. They also spoke of a point in the process which took the form of a crisis, and served to initiate innovation adoption after a long lead phase or gestation period (ibid.).

More recently, in their paper on Internet technology adoption in organisations, King & Gribbins (2002) considered the perspective of the organisation as a whole focusing on the adoption of Internet technologies by 76 varied companies. They provided a background to adoption studies and discussed how Rogers' Innovation Decision Process influenced the TRA (Ajzen & Fishbein, 1980), TPB (Ajzen, 1985) and TAM (Davis 1986) models. The authors re-enforce the observation that most studies in the area, based on these models, have been applied at the individual rather than at the organisational level. Their research determined that factors other than those considered in the TAM model were also important in organisational decisions to adopt new technology, for example, managerial logic and industrial forces (King & Gribbins, 2002). They also found that the technological readiness of the IT department was important in facilitating technology adoption and that "the availability of knowledgeable IT staff can be a key determinant for organisation adoption decision" (ibid., para. 44). They concluded that more work was needed to model and develop a generalisable theory of the adoption of new technologies in organisations (ibid.).

Stages of growth

Nolan's stages of growth model provides an explanation of the stages an organisation goes through in the maturation of its IS infrastructure. Initially the model comprised four stages relating to increased spending on computer technology infrastructure: Initiation;

contagion; control; and integration (Gibson & Nolan, 1974; Nolan, 1973) but was later extended to a 6 stage model, incorporating further stages of data administration and maturity, and emphasising progression in data management (Nolan, 1975, 1979). Nolan's stage model has been criticised by a number of researchers (Benbasat, Dexter, Drury, & Goldstein, 1984; King & Kraemer, 1984) but has retained its popularity and acceptance for initiating research efforts in the area and providing a way for IS managers to address and communicate IT development in their organisations (Benbasat & Zmud, 1999; Huff, Munro, & Martin, 1988; Mahmood & Becker, 1985). Ward and Peppard (2003) describe Nolan's model and point out that although the model has critics, it has made a considerable contribution to its field, possibly in part because of its simplicity. As a result of their research, Mahmood and Becker (1985) suggested that either a new set of maturity variables, or a modification of Nolan's stage model (Nolan, 1975, 1979) would be of interest. Friedman also suggested it was time to consider alternatives in his 1994 paper (Friedman, 1994).

Disruptive innovation

Disruptive technology and disruptive innovation are terms used to describe technologies and processes which revolutionise existing practices (Bower & Christensen,1995; Christensen, Bohmer & Kenagy, 2000; Wachter, 2006). Bower and Christensen (1995) described how companies with successful products have frequently missed opportunities provided by certain new technologies and have been rapidly outperformed by new entrants to their markets who have adopted and further developed those new technologies. Initially these disruptive technologies appeared to be inferior to existing ones, either in performance or profitability, and unattractive to existing customer bases, but quickly overtook their predecessors when developed in new market areas (ibid). Considering health care, Christensen et al., (2000), discussed how the health care industry could harness disruptive technologies and innovations to enable needed reforms, for example, by enabling health professionals to perform increasingly complex tasks formerly undertaken by higher qualified professionals (ibid.). Medical outsourcing to countries where the time zone differences allow assessments to be completed swiftly over 24 hours a day, provides cost and time efficiencies, and the example of international teleradiology was discussed by Wachter (2006), who described it as a disruptive innovation. However, resistance to these innovations exist in health care (Christensen et al., 2000; Wachter, 2006).

2.2.4 Summary of research context section

The three research areas of ‘New Zealand health care’; ‘Trends in health informatics and eCDS’, and ‘Technology adoption and IS status’ (Topics 1, 2 and 3), have been introduced, providing background information and the context of the research. HIT solutions, including the use of eCDS, have the potential to address a range of issues facing health care organisations, including cost containment, improvements to the quality of care, and staff retention. In the context of this research CDS is defined as “Access to knowledge stored electronically to aid patients, carers, and service providers in making decisions on health care” (NEDST, 2003, p. 20), and forms the focus of the study. Various research areas contribute theory to the current research, including innovation diffusion theory, technology acceptance, stages of growth and disruptive innovation and have been introduced in this section. The current research addresses the status of the IS, and eCDS in particular, in the New Zealand primary health care information environment. The following, Section 2.3, illustrates recent work in International HIT research (Topic 4).

2.3 International HIT research

This section reviews international HIT research: ‘International research on health care technology adoption, IS status and eCDS’ (Topic 4) including recent examples of research of interest. The section explores eCDS as its starting point, followed by health care technology adoption. It then reviews organisational readiness/maturity and IT infrastructure research, and finally addresses IT maturity/sophistication.

2.3.1 eCDS research

There is a large body of literature on decision support systems, and the use of such systems in health care (Coiera, 2003; Garg et al., 2005; Hunt, Haynes, Hanna, & Smith, 1998; Kaushal, Shojania, & Bates, 2003; Kawamoto, Houlihan, Balas, & Lobach, 2005; Rousseau, McColl, Newton, Grimshaw, & Eccles, 2003; Turban, Aronson, & Liang, 2005). Coiera (2003) stated that knowledge based systems, or expert systems, are the most frequently used clinical decision support systems (CDSS) used in clinical practice, and described a number of clinical tasks to which such systems could be applied, including: Alerts and reminders; diagnostic assistance; therapy critiquing and planning; prescribing decision support systems; information retrieval; and image recognition and interpretation (ibid.). In a report for the California HealthCare Foundation, Metzger and MacDonald (2002) outlined that decision support tools could assist physicians by:

- Bringing accessible information and knowledge to the point of clinical decision-making;
- Bringing knowledge *relevant to the particular clinical situation* (for example, the specific patient, the specific issue, or the specific medication) to the physician when needed;
- Combining clinical knowledge with patient information to help the physician stay abreast of the patient's health status (for example, identifying preventative interventions that are due or issues requiring follow-up);
- Identifying patients lost to follow-up or overdue for recommended interventions; and
- Alerting the physician to contraindications or potential problems by checking planned actions against other patient information and generally accepted clinical knowledge. (ibid., p. 5)

These tools will be discussed further in Section 3.3.2.

There are a range of sources of eCDS available to health professionals, and this research seeks to discover how available support is utilised. However, many research studies have concentrated on the use of specific systems rather than the use of groups of CDS technologies. This is illustrated by a number of reviews covering studies of particular systems. For example, Hunt et al. (1998) conducted a systematic review of CDSS, concluding that such systems have been demonstrated to be effective in improving prescribing and preventative care but have a limited positive influence in terms of diagnosis. The authors found that the effects of CDSS on patient outcomes still needed to be studied further (ibid.). Later, Garg et al. (2005) updated previous reviews to provide a cumulative systematic review on the effects of CDSS on practitioner performance and patient outcomes before September 2004, with the finding that many such systems had positive effects on practitioner performance but that patient outcomes were still unclear.

Another systematic review studied work on medication safety and the use of computerised physician order entry (CPOE) and isolated CDSS (Kaushal et al., 2003). The authors concluded that medication error rates can be reduced by the use of such systems, but that further research was needed, including into ways that such technology could be successfully implemented. A systematic review of 70 randomised controlled trials aimed at identifying critical success factors for using CDSS to improve clinical practice identified four positive features that such systems should incorporate (Kawamoto et al., 2005). They should: "(*a*) provide decision support automatically as part of clinician workflow, (*b*) deliver decision support at the time and location of decision making, (*c*) provide actionable recommendations, and (*d*) use a computer to generate the decision support" (ibid., p. 7). These features have been found to be of interest in the current study and will be discussed further in Section 3.3.2.

Heathfield, Pitty, and Hanka (1998) pointed out that there are challenges in evaluating health care information technologies by way of randomised control trials which do not necessarily yield information useful for clinicians who are increasingly being involved in making decisions on HIT acquisition and implementation. The authors propose a greater use of evaluation techniques which approach the subject from different perspectives and employ both quantitative and qualitative research methods (ibid.). This view is supported by Kaplan (2001b), in a paper on alternative approaches to the evaluation of CDSS, who argues that "Basing evaluations primarily on an experimental or clinical trials approach answers different research questions from ones concerning the interplay of contextual, organisational, and personal influences that affect whether or not any information system actually is used" (ibid., p. 51). The paper outlines a social interactionist approach which employs both quantitative and qualitative methods, to study clinical systems evaluations in terms of Kaplan's 4Cs framework of communication, care, control and context (Kaplan, 1997). The fact that most studies concentrate on physicians, excluding the wide care team was noted (Kaplan, 2001a, 2001b). The author concludes that the exploration of a number of questions through a multi-method approach would impart rigour to the study, increase its relevance to the clinical situation, and increase the likelihood of it contributing to improved patient care. The current research incorporated a mixed method approach and canvassed the opinions of a range of health care professionals in order to increase rigour and relevance in the study.

A further example of the interactionist approach includes where an area of interest regarding CDS was highlighted by Sittig et al. (2006) who surveyed a group of primary care physicians in Portland, Oregon. They found that although the respondents were favourably disposed to CDS they did not follow most of the recommendations provided by their systems. The type of patient being dealt with and environmental factors were found to be influential in the decision to accept or ignore CDS, and the physicians felt they would derive more benefit from CDS suggestions given a greater amount of time (ibid.). A UK qualitative study of barriers to the use of a computerised DSS for risk assessment during GP consultations also found that time restrictions were an issue (Short, Frischer, & Bashford, 2004). In addition, they identified concerns about DSS effects on the doctor/patient relationship, user skill levels, barriers caused by infrequent use, and problem associated with both GPs' and patients' abilities in interpreting risk assessments provided by the system being studied. Measurements of absolute as opposed to relative risk reduction were mentioned as an example by one doctor interviewed, who thought they were hard to understand and would be very difficult to explain to patients (ibid.). This problem was illustrated very well by Skolbekken (1998), who gave examples of how the presentation of data could influence the perception of both doctors and patients when assessing risks and benefits of certain treatments. Other researchers also determined that practitioners who were non-users of clinical systems were concerned about computers potentially disrupting the doctor-patient encounter, and the costs of computerisation (Johnston, Leung, Wong, Ho, & Fielding, 2002). It was suggested that these challenges concerning practicalities and the level of knowledge of users needed to be addressed by system developers (Short et al., 2004).

Rousseau et al. (2003) reporting on a longitudinal, qualitative study of the use of computerised evidence based guidelines in UK primary care, also identified concerns. They found that CDSS for chronic disease management were difficult to use and unhelpful for GPs, with relevance, accuracy and fit within the consultation setting being cited as problem areas. A parallel randomised controlled trial was reported earlier in other papers, and found low rates of CDSS use with no effects on outcomes for patients or care processes (Eccles et al. 2000; Eccles et al. 2002). The researchers commented on the efficacy of parallel qualitative studies to throw light on reasons for results, and praised the synergy of the use of qualitative and quantitative measures together. Other areas of concern to clinicians, have been issues around professional autonomy and litigation (Kaplan, 2001b) with the use of CDS seen as potentially problematical in these areas. Purcell (2005), pointed out that many researchers have sought to determine the advantages of CDS whereas there have been few studies of its detrimental effects. It is clear that there are challenges surrounding the use of eCDS technologies. The identification of barriers to their improved use would therefore benefit the health care information environment.

Existing CDS studies have largely been concerned with patient-based CDM, and there is a need for further work in this area. However, there is also a need for CDS studies addressing issues surrounding population-based decision making. New Zealand PHOs are organisations which encompass both population-based and patient-based CDM, therefore providing an ideal environment for research to be carried out in these areas. The current research explores this domain from the perspectives of functional groups, using a range of technologies providing CDS, within an organisational setting, and with the use of mixed methodologies.

2.3.2 Health care technology adoption

Much research has been carried out using variations of the Technology Acceptance Model (Davis, 1986, 1989; Davis et al., 1989), which have been applied in a wide variety of situations, including health care. Chau and Hu, (2001, 2002a) sought to determine the appropriateness of the TAM model (Davis, 1986, 1989; Davis et al., 1989), the TPB (Ajzen, 1985), and an integrated model, in their study of the adoption of telemedicine by health professionals in Hong Kong. Some of their findings led them to question the validity of applying instruments, developed and used in studies of general end-users and managers, to professionals for which they might be inappropriate (Chau and Hu, 2001, 2002a). Physicians were atypical from previously studied subjects in that perceived usefulness scored more highly with them than did ease of use. It was postulated that this could, in part, be due to their high level of capability and ability to master new systems (Chau and Hu, 2001, 2002a, 2002b).

Yi, Jackson, Park, and Probst, (2005) developed a unified model based on the Technology Acceptance Model (Davis, 1986, 1989; Davis et al., 1989), the TPB (Ajzen, 1985), and Innovation Diffusion Theory (Rogers, 2003), applying it to PDA acceptance by health care professionals. They consider the UTAUT model (Venkatesh et al., 2003), and discuss the work of Chau and Hu (2001, 2002a, 2002b). Yi et al., (2005) were in agreement with Chau and Hu, in finding that a physician's intention to accept a technology was most influenced by its perceived usefulness. They also agreed with them in finding that perceived behavioural control was important, indicating that technology acceptance could be enhanced by appropriate resourcing and training. However, they found that the perception of subjective norm also had a significant effect on behavioural intention, implying that social networks could play an important role in technology acceptance. The authors stated that an individual's innovativeness with IT influences their acceptance behaviour and the identification of individuals with a strong tendency in that area could be beneficial where a new technology was being introduced, as they had the potential to become change agents or opinion leaders. Work by Chismar and Wiley-Patton (2003) with health care professionals, was in agreement with the finding that perceived ease of use was not predictive of the intention to use a system, whereas perceived usefulness was an important determinant, in their study of the intentions of paediatricians to use Internet-based health applications. In other health care research, Paré, Sicotte, and Jacques, (2006) used the TAM model as the starting point for a study which determined that psychological ownership is an important factor in the acceptance of a physician order entry system by users in a community health network.

Other adoption research, considering the organisational perspective, has been carried out in the health care area in recent years. For example, McAlearney, Schweikhart, and Medow (2005) address issues surrounding the facilitation of handheld computer use in clinical practice, from organisational and physician perspectives, in their qualitative study. However, groups of technologies, and/or multi-purpose technologies are also of interest in adoption studies, such as those on technologies used for administrative and clinical purposes in health care. A study of clinical practice computerisation in Hong Kong found a relatively low level of computerisation in general, in individual practices as opposed to those which were part of corporate organisations (Leung, Johnston, Ho, Wong, & Cameo, 2001). This poses the question of whether the membership of New Zealand primary health care practices in their PHOs has an influence on their adoption of technology, which is addressed in the current research.

Poon et al. (2006), approached the subject of HIT in the US by studying the adoption levels and barriers to adoption associated with a range of technologies providing major functionalities desirable for eight different stakeholder groups, including physician practices, focusing on systems with the potential to improve patient safety, care quality and organisational efficiency. The authors found that systems associated with financial benefits exhibited a greater adoption level than those associated with quality and safety improvements, and felt that HIT adoption would continue to be limited without increased financial resources becoming available (ibid.). The article presented results from qualitative research in two regions of the US, and data collected was rated against the innovation adoption curve (Rogers, 2003) in the first part of the study (Poon et al., 2006). These results were then presented to a panel of experts in a modified Delphi round, to contribute to the discussion of their estimation of national adoption rates for the technologies by the eight stakeholder groups. The authors admitted the possibility of bias in their work (ibid.) and the second part of their study would seem to be particularly vulnerable in this respect. Therefore, further work is indicated towards a national assessment of HIT adoption in the stakeholder groups identified. However, the first part of the study provided an interesting approach with results indicating a slow rate of adoption of HIT in general which is likely to be maintained without an increase in available financial resources. Physicians' practices were found to be particularly vulnerable in terms of financial constraints and increased workloads (ibid.), a finding which could be reflected in New Zealand practices.

In their report for RAND Health, Fonkych and Taylor (2005) concluded that: "The strong evidence that HIT adoption spreads within a short time across integrated healthcare delivery systems suggests that a potential target for policy incentives is the corporation rather than the individual providers" (p. 50). This observation could have implications for New Zealand PHOs, with individual GP practices joining together in the new organisational structures. PHOs might potentially have a greater capacity for implementing and supporting IS within their organisation than do their individual members.

2.3.3 Organisational readiness/maturity and IT infrastructure

The research in this section illustrates a variety of approaches to the study of organisations and their IT infrastructure, and includes examples from primary and secondary health care. While aspects of the studies were considered for their potential development and application in the current study, none were found to fulfil requirements for the purpose, but helped to clarify the boundaries of the research.

Organisational IT planning

Although not in the health care area, the following paper was of interest as it explored the role of IT sophistication in the IT planning process. Byrd, Sambamurthy, and Zmud, (1995) defined IT sophistication as "…the extent to which the core infrastructure technologies have been embedded into the organisation's value chain activities" (p. 53), referring to microcomputers, database management systems, database administration, local area networks, and electronic mail, for the study in question. A high level of IT infrastructure sophistication would be considered to be where an organisation utilised an integrated database architecture (ibid.). Byrd et al. (1995) used a multiple case study strategy applied within eight agencies of a large state government, to explore relationships between the behaviours and actions of people contributing to the IT planning process, contextual factors, and quality of outcomes of the process. Contextual factors included organisational size, aspects of IT infrastructure, and environmental issues. IT infrastructure included IT sophistication and IT innovativeness. IT innovativeness was said to refer to the behaviours associated with the adoption of those technologies, with early adopter organisations being expected to have acquired learning which could contribute to more effective planning with respect to the alignment of business and technology issues (ibid.). An important finding of the study was that it is important for large agencies to have sophisticated and innovative IT infrastructures. Superior IT plans were associated with "…large public organisations with mature IT infrastructure…" (ibid., p. 66). However, smaller organisations were found to be successful in gaining help from external sources which compensated for weak IT infrastructure (ibid.).

Organisational information technology/systems (IT/S) innovation model

The relationship between organisational readiness/maturity for IT adoption, and an organisation's IT infrastructure has been addressed more recently in the health care area. Organisational readiness for CIS innovation was studied by Snyder-Halpern (2001, 2002), who developed the organisational information technology/systems innovation model (OITIM). This model incorporates technology readiness as one of the eight sub-dimensions of the IT/S innovation readiness dimension (Snyder-Halpern, 2001). From this conceptual model the organisational information technology/systems innovation readiness scale (OITIRS) was developed for the measurement of the construct (Snyder-Halpern, 2002; Snyder & Fields, 2006).

Snyder-Halpern (2001) developed the OITIM model from studies in the secondary care sector of the US health system. The model was developed from a literature review and a two round Delphi study with high level health IT/S professionals. Potentially important aspects of health organisation readiness for the introduction of new IS solutions were identified, and verified through the first round of the Delphi study. This resulted in the identification and ranking of eight 'sub-dimensions': Knowledge, end users, technology, management structures, administration support, processes, resources, and values and goals. External environmental factors and organisational characteristics, which can inter-react, influence the sub-dimensions identified, and these factors will all have an effect on the processes undertaken in any systems development effort (ibid.). The second round of the Delphi study was used to collect examples or 'indicators' of these sub-dimensions. From this model the assessment tool 'OITIRS' was developed (Snyder-Halpern, 2002). The technology sub-dimension of the OITIRS was defined as "IT/S infrastructure (e.g. hardware, software, networks, wiring, and systems integration)" (ibid., p. 703), and places the consideration of technology maturity in the overall context of organisational maturity. The scale was designed to produce a final figure which would indicate an organisation's innovation readiness, with a higher score relating to a higher level of readiness (ibid.). A paper reporting the fourth phase of the OITIRS was published in 2006 (Snyder and Fields, 2006), but no other research on the model or scale has been forthcoming. The use of a similar approach to study the IT readiness in New Zealand PHOs would be interesting, but beyond the scope of the current study due to time and resource limitations.

Organisational maturity

The role of IT in organisational development was acknowledged in research by Elwyn et al., who assessed organisational development in primary health care using an assessment tool they named the Maturity Matrix^{TM} (Elwyn et al., 2004). The authors describe the instrument as comprising a set of eight areas of general practice activities contributing to organisational development. The areas included are clinical records, audits of clinical performance, access to clinical information, use of guidelines, prescribing monitoring, practice based organisational meetings, sharing information with patients, and patient feedback systems. The assessment tool was designed to be used at both the individual and group level of various health professionals working within primary care practices to collectively assess the development of their organisations. By using the tool, individual practice results can be compared to aggregate figures collected from other practices assessed, and organisations can visualise areas where improvements are needed.

The Maturity Matrix^{TM} was found to be well received by participants of the study, and thought to be useful for future development planning exercises in primary care. However, due to the focus of the assessment tool on practice activities, the role of IT is only apparent in a relatively small number of the tools 'cells', although they were present generally at the more mature end of the activity spectra. The authors acknowledge that the 2002 version of their assessment tool needs to be developed further, and mention the fast pace of change in the influence of IT in health care amongst other areas which need attention. In conclusion Elwyn et al. (2004) state that further development of the tool will "…ensure [its] acceptability for summative work (benchmarking) and formative feedback processes (quality improvement)" (p. 287). Therefore, although their approach is an interesting one which does encompass an assessment of IT status and its support of various activities in primary care organisations, the use of a similar approach and tool development would not be appropriate for the current study as IT, and more specifically eCDS, are not the tool's primary focus.

Roger's diffusion of innovation studies (Rogers, 1995, 2003) and Nolan's stage theory (Nolan, 1975, 1979) provided the foundation for Australian research on the process of IT adoption in the health care sector (England, Stewart, & Walker, 2000; England, & Stewart, 2003). England et al., (2000), found that the relatively slow adoption of IT in health care could be explained in the light of an exploration of organisational and technical factors influencing organisational innovativeness suggested by innovation research. England and Stewart (2003) went on to expand on Nolan's concept of IT maturity in organisations, from being related to expenditure on IT, to include a wider range of factors, by comparing the banking and health care industries. The descriptive study was based on a UK survey for the assessment of hospitals' IT maturity for clinical systems projects (Gronlund and Crouch, 1997, cited in England and Stewart, 2003). A slower rate of IT adoption was confirmed in health care, which was considered to have a lower level of IT maturity (England and Stewart, 2003). The banking industry exhibited higher maturity in the following major factors measured: IT vision, IT culture, IT communications, IT standards, information attitude, and vendor attitude (ibid.). Health care organisations exhibiting higher maturity levels, overall, than their counterparts, had higher levels in cost allocation and more clinician input into IT project planning.

A number of other researchers have sought to clarify the sophistication/maturity of, specifically, the IT in organisations. This research includes work in Canadian secondary health care by Paré and Sicotte (2001), who developed and verified a tool to enable the comparison of IT sophistication in groups of hospitals. Their work will be discussed in depth in the following section as it was selected to form a basis for part of the current study which adapts the work for application in New Zealand primary health care.

2.3.4 IT maturity/sophistication

The increasingly sophisticated support provided for business processes by IS was described by Stair and Reynolds (1999) who described a hierarchy of system types. The hierarchy from bottom to top comprises transaction processing systems (TPS), management information systems (MIS), decision support systems (DSS) and finally artificial intelligence/expert systems (AI/ES). There is a progression from large volumes of data utilised in a routine fashion with a high level of input and output by the TPS at the bottom, to the sophisticated and complex processing and analysis of information, providing decision support, by the DSS, and lastly AI/ES at the top. Within the hierarchy, MIS are designed to provide support to managers by providing them with reports on regular operations within the organisation, which help them to respond to feedback and make decisions (ibid.), and above those are DSS. O'Brien (1999) described DSS as "…interactive, computer-based information systems that use decision models and specialised databases to assist the decision-making processes of managerial end-users." (ibid., p. 61)

As organisations have progressed in terms of their IT infrastructure, the complexity, or sophistication, of their systems has also progressed. With this has come the desire for ways of assessing, or benchmarking the IT sophistication in organisations. Various approaches and tools for the assessment of IT use in health care have been reported (A.C. Nielsen, 1998; Culler et al, 2006; Didham, Martin, Wood, & Harrison, 2004; Grant, Campbell, Gruen, Ferris, & Blumenthal, 2006; Henderson, Britt, & Miller, 2006; Western, Dwan, Makkai, del Mar, & Western, 2001; Western, Dwan, Makkai, & del Mar, 2003). A 1998 report prepared for the General Practice Brach of the Department of Health and Family Services (ACNielsen, 1998) on the levels of, and attitude to, IT in General Practice in Australia, found that research in the area at that time was limited, with sometimes biased methodologies and terminology which were hard to interpret. They felt the term ‘computerisation’ needed to be clarified and discussed the need to differentiate between its use for administrative and/or clinical purposes, identify the task divisions in the practices, and determine the patterns of computer usage within multiple practitioner practice environments (ibid.). Both quantitative and qualitative methods were used in the report which provided the basis for a further study of Australian general practice computerisation (Western et al., 2001; Western et al, 2003).

Computer usage patterns in Australian general practice were benchmarked using interviews and telephone surveys (Western et al., 2001; Western et al., 2003). The authors divided computerised primary care functions into three task groups: clinical; patient oriented administrative; and general administrative. Despite their potential for improving clinical outcomes for patients generally, functions such as the use of computerised CDS systems were found to be used less than other computerised functions (Western et al., 2001; Western et al., 2003). Also in Australia, a 2006 paper reported that 6% of GPs did not have a computer at their practice, with 5.2% of GPs not using a computer at work where one was present, and where clinical software was available 6.6% of doctors did not use it (Henderson et al., 2006). Most GPs who did use a computer at work used it for electronic prescribing, test ordering, and recording certain patient information, but only a third recorded all patient information in an EMR (ibid.). Of the GPs surveyed, 21.7% were keeping all data in electronic format and utilising all available clinical functions (ibid.).

In the US, Grant et al. (2006) also reported low rates of CDS adoption in clinical practice. The authors contributed questions to a mail survey of US physicians, including some working in primary care. Their five questions related to physicians’ use of IT with respect to e-mail, CDS during consultations, and on-line activities. The results suggested that although the technologies studied were relatively easy to acquire, they were only being used by a minority of physicians to support clinical care (ibid.). However, another US study in 2002, employed case research on the use of IT in small physician practices, and found that doctors and practice staff were experiencing benefits from new IT they had implemented at their practices (MacDonald, Metzger, & Mann, 2002). The report concluded that small practices were now in a position to adopt many new information technologies, beyond those used for administrative purposes (ibid.). These findings suggests that health care technology adoption in primary care practices is poised for advancement, after a long lead phase, and is likely to include the greater use of CDS technologies. Such technologies are readily available and some health professionals are enjoying benefits from their use, but questions remain about their increased adoption by others. Studies conducted in New Zealand in this area will be discussed in Section 2.3.4.

Canadian and US researchers have also used postal surveys to determine and compare IT sophistication, in groups of secondary care facilities (Culler et al, 2006; Jaana, Ward, Paré, & Wakefield, 2005; Paré and Sicotte, 2001). Culler et al. (2006) stated that existing studies of adoption of IT in health care had shown that rates for IT applications are usually higher in institutions which are part of a hospital system, are larger, or are urban hospitals, and contributed further knowledge with a study of urban and rural hospitals. The authors' results included the finding that there were significant differences between the two hospital groups, with urban hospitals exhibiting higher levels of IT sophistication in both functional applications and technological devices (ibid.). This area of research enables comparisons between institutions and the identification of areas where improvements can be made, and provides a useful mechanism which can be employed in the study of IS in New Zealand PHOs.

IT maturity

Although not in the health care area, the concept of information systems maturity was considered by Saunders and Keller (1983) who presented a model of IS/organisational fit through which the maturity of the IS function was studied in relation to patterns of inter-departmental communications. Their study showed that the relationship between increased inter-departmental communications and greater IS maturity was significant for certain information areas such as accounting, as was the relationship between increasing IS maturity and the complexity of user tasks. However, no relationship was determined between IS maturity and the interdependence of departments (ibid.). IS function maturity levels were described as referring to "the sophistication of the mix of applications provided by the information system function" (ibid., p. 118). Sophistication was considered to encompass both the technological level and variety of the applications used, but it was acknowledged that not all available systems are actually used, and thus measures of IS information product use, and use of computers were included. IS managers were also consulted regarding IS maturity levels (ibid.).

Applying the concept of IT maturity in health care, Vimarlund, Sjöberg, and Timpka, (2003) proposed a classification of health care organisations as either traditional, developing, or flexible. They identified characteristics useful for the description of IT maturity for each organisational type and suggested that the consideration of these characteristics would be beneficial in informing development efforts. However, a number of the characteristics presented appeared to be derived from information on manufacturing or business, rather than health care organisations. For example, one rationale for IT investment was listed as “To introduce new or change products and/or services”, and a use for IT was suggested as “To develop new production processes” (ibid., p 470). Whilst, given a little imagination, these could be applied to health care, the lack of consideration of IT support in areas such as patient care, clinical decision-making, or privacy, lead one to suspect that the research needed to encompass a greater input from representatives of the health care domain. Therefore, although they sought to address the issue of IT maturity in health care organisations, they would need to extend their research in the area to substantiate their claims, and their approach was not appealing for further development in the current research. However, a suitable approach was found in the work of Paré and Sicotte (2001) which is described in detail in the following passages.

IT sophistication

In their book, Austin and Boxerman (2003), describe four categories for computerised health care information systems. They suggest that health care systems fall into categories of either clinical, management, strategic decision support, or electronic networking and e-health applications and give examples for each category. A framework devised by Paré and Sicotte (2000, 2001) and later applied by others (Culler et al., 2006; Hart, 2006; Jaana et al., 2005) complements and supports these categories in many respects. According to Austin and Boxerman (2003), firstly, clinical systems include EMRs, systems in clinical departments such as pharmacy, CDS systems, and also systems used in research and education, and automated treatment equipment. Secondly, operational management systems are used for activities not associated with the care of patients. Thirdly, integration of information from both clinical and management systems, together with data from outside organisations, provide input for strategic decision support systems used for “…strategic planning, managerial control, performance monitoring, and outcomes assessment.” (p. 11), highlighting the importance of the electronic integration of systems. Lastly, the authors explain the use of web-based applications for Electronic Data Interchange (EDI) and e-health (ibid.).

In response to the lack of an assessment tool for the determination of IT sophistication in hospitals, Paré and Sicotte (2001) provided and validated a tool for that purpose. Firstly, Paré and Sicotte reviewed the MIS, health management and medical informatics literature for information on the characterisation of IT sophistication, considering work, for example, by Hatcher (1998) who studied various aspects of the influence of information systems in different domains of acute care hospitals, and Singh (1997) who studied technological complexity. Paré and Sicotte (2001) defined IT sophistication as:

> …a construct, which refers to the diversity of technological devices and software applications used to support patient management and patient care, clinical support, and administrative activities...also…the extent to which computer-based applications are integrated…. (p. 207)

'Diversity' and 'integrated' are key words in the definition, and are reflected in the conceptual framework of IT sophistication which was developed. The framework was based on three dimensions of IT sophistication: technological sophistication (computerised hardware), functional sophistication (computerised processes and activities), and integration sophistication (internal integration of systems via shared databases, and external integration via electronic communications). These three dimensions were combined with three domains of the hospital: patient management (e.g. waiting list management and patient admission) and patient care activities (e.g. care planning and results reporting), clinical support activities (e.g. pathology, radiology and pharmacy), and administrative activities (e.g. payroll and purchasing). A representation of the conceptual framework is provided in Figure 2.2.

The operationalisation of the three dimensions (technological, functional, and integration sophistication) was carried out, firstly by gathering information from the literature, and secondly, by conducting interviews with 20 hospital health care and IT specialists. As a result, detailed lists of technologies and applications, processes and activities, and internal and external integration details were identified, together with information on other IT used in other North American hospitals, for inclusion in the assessment tool.

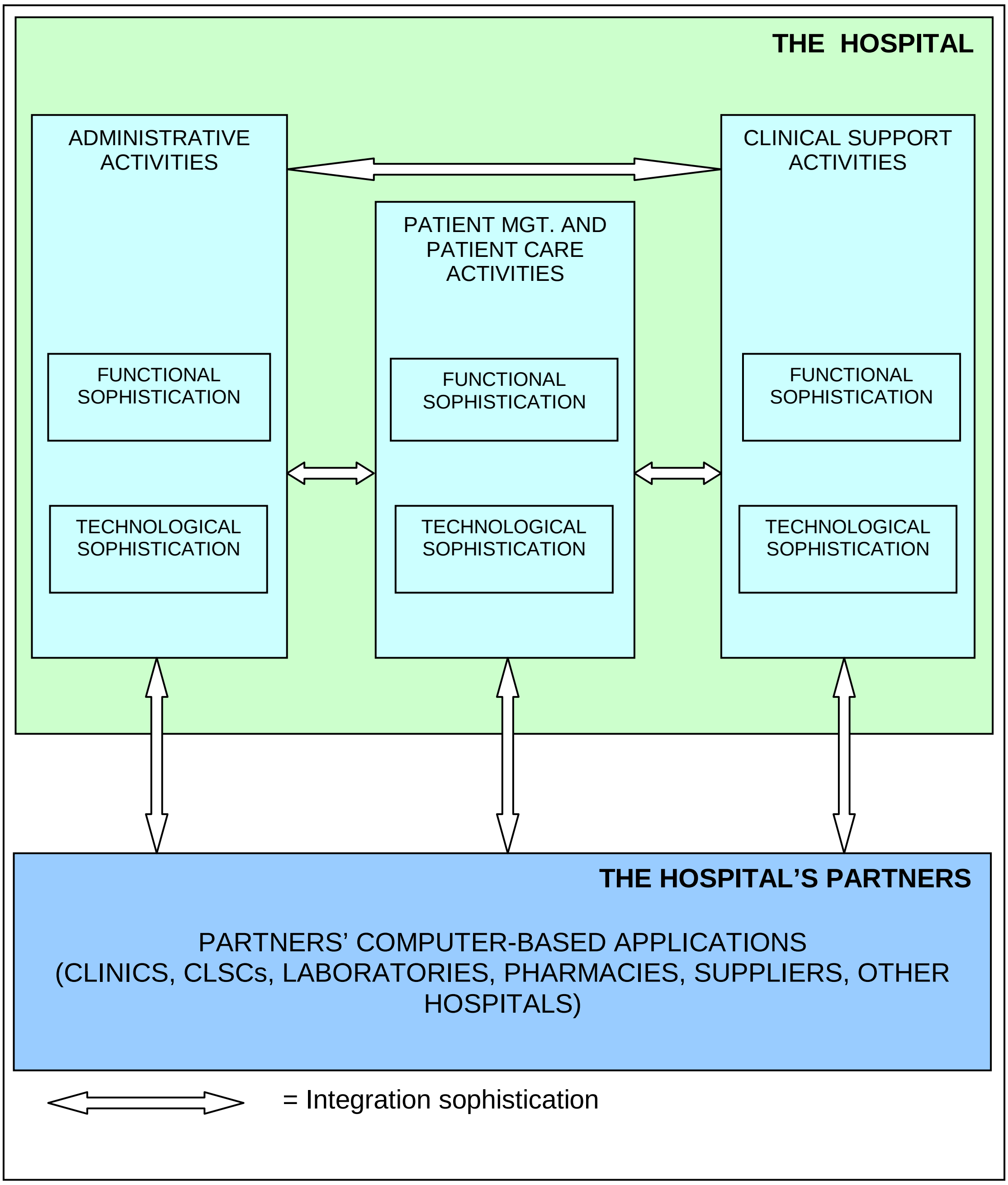

Figure 2.2: Paré and Sicotte's Conceptual Framework of IT Sophistication in Hospitals (Paré and Sicotte, 2001)

The interviews added information and thus content validity to the basic tool derived from the literature review, by informing the complete set or universe of possible content, or 'universal pool', referred to by Paré and Sicotte (2001) and Kerlinger (1992). Kerlinger stated that "Content validation is guided by the question: Is the substance or content of this measure representative of the content or the universe of content of the property being measured?" (ibid., p. 417). This was partly achieved through the consultation with experts in the field providing content evaluation outlined by Cronbach (Cronbach, 1951, as cited in Paré & Sicotte, 2001). This process was followed by a pre-testing of the tool with it being sent to three hospital information systems directors who assessed the questionnaire and were then interviewed for their comments. After responding to points raised in this last step, the instrument was finalised. Theory building and rigour in case study research was discussed (Dubé and Paré, 2003; Paré, 2002) with reference to the work of other researchers in IS and other areas (Benbasat, Goldstein, & Mead, 1987; Eisenhardt, 1989; Lee, 1989) reflecting the approach taken in the earlier study (Paré and Sicotte, 2001).

The final instrument for the determination of IT sophistication in hospitals was validated in terms of content validity, reliability (Cronbach's alpha), construct validity, and concurrent validity. This was achieved through a survey of health information systems (HIS) directors in Quebec and Ontario, with 59 and 57 participants respectively, reflecting an overall response rate of 62.4%.

In conclusion to their paper on the same study, Paré and Sicotte (2000) state that their framework "…can be used for further study and extension of the IT sophistication construct to health care institutions other than hospitals" (ibid., p. 17) and point out that:

> Our measurement instrument can also be used as a diagnostic tool by hospital managers interested in better situating their institution in terms of its adoption and use of information technologies. Of most importance, it can be useful in investigating the link between IT sophistication and hospitals' performance measures… . (Paré and Sicotte, 2000, p. 18)

The study found a moderate to high level of functional sophistication amongst the organisations studied, with a lower level of technological sophistication, and limited systems integration. The need for the introduction of additional technologies, and improved integration of administrative and clinical systems was suggested by the authors. In terms of IT sophistication and perceived usefulness of systems, a moderate to high correlation was found between the two constructs for clinical systems in both provinces, but no significant correlation was found between IT sophistication and the perceived usefulness of administrative systems in Quebec.

The utility of Paré and Sicotte's assessment tool for determining the IT sophistication in hospitals is illustrated by several studies since. In her Ph.D. dissertation Hart (2006) incorporated Paré and Sicotte's work on IT sophistication (2001) to explore the construct's relationship with clinical and financial outcomes in acute care hospitals in Texas. Other work was carried out by Jaana et al. (2005), who applied the tool to Iowan hospitals, and Ward, Jaana, Bahensky, Vartak, and Wakefield, (2006), who used it to focus on the study of CIS in Iowan hospitals. Ward et al. (2006) described the focus of their study as a comparison of CIS within rural and urban hospitals which “sheds light on the relative starting point for assessing variation in clinical support applications, decision support, and electronic medical record “readiness”” (p. 430). This paper, therefore, moved away from the more general earlier work which provided an overview of the IT sophistication of hospitals, including their administrative systems (Jaana et al. 2005; Paré and Sicotte, 2000, 2001). A subset of data used in their earlier paper (Jaana et al. 2005), was used by Ward et al. (2006), to study the availability and usage of CIS applications in particular, in the areas of patient management, physician support, nursing support, emergency department support, operating room management, laboratory management, radiology management, and pharmacy management. The greatest differences between rural and urban hospitals were noted in the areas of laboratory and radiology management systems where their provision and usage were much higher in urban hospitals, and more than twice the number of urban compared to rural hospitals reported the computerised collection of basic clinical information which could be used in EMRs and CPOEs. Discussing their survey in general, the authors commented on the need for further work to determine how such systems are used (Ward et al., 2006). In the current research, a similar tool, based on the IT sophistication framework is developed for use in New Zealand PHOs, and in addition qualitative techniques are used to further study the use of technologies in CDS.

Ward et al. (2006) go on to explain their findings in the light of IT adoption in the health care sector and discuss the generations of health IT acquisition as described by Chu (1993). Chu outlines HIS development from a first generation of mostly stand-alone administrative and accounting systems, through further computerisation of administrative systems and the introduction of systems used in patient care, in second and third generations of HIS respectively. Chu’s fourth generation of fully integrated point-of-care clinical systems providing CDS, and access to hospital policy and procedures and staff education for nurses, was still to be achieved (ibid.). Ward et al., (2006) describe systems involving “comprehensive clinical decision support systems and complete interoperability” as a fifth generation (Ward et al., 2006 p. 437), which they found to be greatly lacking in most large Iowan hospitals. They went on to compare their findings to the ‘steps on the road to interoperability’, described by James (2005). James describes the first three of six steps as “…automated patient scheduling and billing (Step 1)…full data automation [in laboratories, pharmacies and imaging departments] (Step 2)…Initial EMR implementation (Step 3)…” (ibid., pp. 27-28), and finally describes a three-stage encoding process as the last step toward interoperability (Steps 4-6). Ward et al (2006) concluded that Iowan urban hospitals are at Steps 2 and 3, whilst their rural counterparts are at Steps 1-2 with most still at Step 1.

In their study of the antecedents of clinical IT sophistication in hospitals, Jaana, Ward, Paré, and Sicotte, (2006) furthered their study of the area. The authors tested a model using their 2002 data on IT sophistication in Iowan hospitals, and secondary data from the American Hospital Association (AHA) annual survey of hospitals for the same year. Their theoretical model consisted of variables in the four conceptual domains of structural, financial, leadership and knowledge sharing capacities. Their results suggest that leadership resources and knowledge sharing are the most important predictors of clinical IT sophistication in hospitals, finding significant relationships with both the length of tenure of IT managers and their technical knowledge. The length of tenure of managers had a negative effect suggesting the possibility of them, for example, becoming resistant to change, and indicating that attention should be made to staffing. The authors concluded that human factors appeared to be of primary importance in relation to a hospital's clinical technology innovativeness.

IT munificence

Having reviewed the work of Paré and Sicotte (2001) and research based on their framework, this part of the review will be concluded with a comparison of their approach with that of Burke, Wang, Wan, and Diana, (2002), and Burke, and Menachemi, (2004) and the concept of IT munificence. According to Burke et al., (2002) there is a lack of information regarding the adoption and categorisation of IT in health care. The authors conducted a quantitative study on IT adoption in short-term acute care hospitals, based on 1999 data gleaned from the Dornfest IHDS+ Database (version 2), and the American Hospital Association (AHA) Annual Survey, 1998 (Burke et al., 2002). Partly based on work by Rogers, clusters of technologies were determined to profile the hospitals and were described as administrative, clinical, and strategic systems, with a combination of 'all IT' as a fourth measure. The study found that strategic IT is adopted more often by hospitals with a higher general level of IT adoption, with hospitals exhibiting lower levels of IT adoption most often adopting administrative systems. Larger hospitals were also found to have a higher level of IT adoption (ibid.).

The concept of IT Munificence was proposed as a latent construct of IT capability, being derived from diffusion of innovation theory and strategic contingency theory

(Burke & Menachemi, 2004). The authors state that munificence is "…a measurement of resource abundance and the capacity to support growth." (ibid., p. 208). The concept of technology clustering was borrowed from diffusion of innovation theory which states that "A *technology cluster* consists of one or more distinguishable elements of technology that are perceived as being interrelated." (Rogers, 2003, p. 14), and is incorporated into their framework in the form of IT dimensions. Strategic contingency theory contributes the concept that strategy can contribute to organisational design and success, and "…a strategically focused measure of IT must also reflect the capability to provide value to stakeholders." (Daft, 2001, as cited in Burke & Menachemi, 2004, p. 209). The measurement model of Bourke and Menachemi (2004) consists of four dimensions of internal IT: Clinical IS, administrative IS, strategic IS, and enterprise IS integration, together with three dimensions of external electronic linkage: Clinical, public (including patients), and business, as variables of IT munificence. The internal IT dimensions represent the technology base with the external dimensions representing stakeholder capability.

The model demonstrates some parallels with Paré and Sicotte (2001), in that clusters of technologies are identified and the importance of systems integration is recognised, both within the organisation and with external partners. However, Burke and Menachemi (2004) separate strategic systems by parting management systems from the administration dimension, and the external partner linkages are divided into three groups.

Burke and Menachemi (2004) present their view of the measurement of hospital IT capability as reflected by the variety of IT infrastructure supporting hospital stakeholders, whereas Paré and Sicotte (2001) present an approach to the measurement of hospital IT sophistication indicated by the amount of use of the variety of IT infrastructure supporting activities and processes, and their integration within the organisation, between similar and dissimilar systems, and with external partners. Burke and Menachemi's study (2004), confirmed that their measurement model represents the concept of IT munificence reflecting the lavishness of IT infrastructure and its growth supporting capacity. They outline how it is flexible by its inclusion of external entities, and could be used to explore a number of organisational outcomes, but explain that the use of secondary data was limiting. The authors also concede that:

> Future studies should be structured to identify causal relationships using IT munificence and should incorporate alternative organisational measures of IT such as the actual integration of data across different technologies and

> organisational functions from a process perspective; the extent to which hospital personnel understand the technology; and the degree to which the available technology is actually used. (p. 215)

In their IT sophistication framework, Paré and Sicotte (2001) address some of these issues by considering integration across similar and dissimilar systems, functional sophistication, and the range and usage of technologies. The current research incorporates this approach for the study of IT sophistication, and eCDS utilisation, in New Zealand PHOs.

2.3.5 Summary of International HIT research

This section has presented a review of work in International HIT research: 'International research on health care technology adoption, IS maturity and eCDS' (Topic 4), and provided an overview of recent research which is of interest in the current study. The research areas have been explored for themes which could inform research in the area of eCDS in New Zealand PHOs. Both quantitative and qualitative research approaches have been discussed and areas of interest highlighted. eCDS is available to health care professionals through different sources, via a range of tools and supportive features. However, a number of issues surrounding the use of eCDS have been cited in the literature. Research studies have commonly concentrated on the use of specific CDSS rather than the use of groups of technologies for the support of CDM. This research seeks to discover how available eCDS is utilised by primary health care professionals, using a multi-method approach. An organisational perspective has been chosen for the current study, and various strands of IS research, leading to the concept of IT sophistication, have been reviewed. This has provided an appropriate framework for the research to be based upon. The following section is devoted to research on New Zealand HIT research.

2.4 New Zealand HIT research

This section reviews New Zealand HIT research: 'New Zealand health informatics and eCDS', and 'New Zealand research on health care technology adoption and IS status' (Topics 5 and 6). Research in these areas is discussed, followed by the definition of the thesis area: 'IT sophistication and eCDS adoption in New Zealand PHOs' (Topic 7).

2.4.1 Health informatics and eCDS in New Zealand primary health care

The Ministry of Health in New Zealand, and health care providers internationally, consider that greater use of CDS technologies will help to alleviate current health care challenges (Hider, 2007; NEDST, 2003; WAVE Advisory Board, 2001). Decision support in primary health care can be provided by a number of technologies including Practice Management Systems (PMS), e-mail, the Internet, stand alone Decision Support Systems, etc. (Bannink, Wells, Broad, Riddell, & Jackson, 2006; Engelbrecht, Hunter, & Whiddett, 2004a, 2004b; Riddell, Jackson, Wells, Broad, & Bannink, 2007; Wells, et al., 2007; Whittaker et al., 2006).

In an editorial, Gillies (2005) described currently available clinical tools as:

- Alerts and reminders, both for efficient time-management and also for recalls of patients for various procedures such as immunisations, etc. Alerts for prescribing are available aimed at reducing the risk of the patient being prescribed incompatible medications.
- Diagnostic tools to assist the clinician at the point of care both in developing an appropriate differential diagnosis, and also in refining the answer by recommending differentiating tests.
- Evidence-based health information in focussed form that is readily available to the clinician at the point of patient contact.
- "Expert" opinions are available especially involving the transmission of data from organ imaging scanning technologies. (ibid., para. 3)

Gillies (2005) suggested that the adoption of such technologies would be facilitated by the tools being readily and rapidly available on demand, user friendly, reliable, relevant to individual patients and localities, current, and focused for specific user types.

Dovey et al., (2006), used a mixed method approach consisting of focus groups and a postal survey, to study the clinical information needs of New Zealand GPs and the resources they used to access that information. They found that GPs most needed drug information, and least needed information on new research on rare conditions and international health threats. The authors described the most useful information as being "concise, clear, timely, trusted, attractively presented, and 'owned' by GPs" (Dovey et al., 2006, p. 18). Personal contacts were important clinical information sources by being both frequently used and highly trusted. It is interesting to note that information of a less trusted nature would be considered by GPs if easily accessed and attractively presented (ibid.). The focus group component of the research contributed the following quotation, from a participating GP, which emphasised the limitations and needs experienced by GPs in information acquisition. The comment contributed to the title of the research paper: "…I literally don't have the space or time…I find the simple things…a single page, really simple, summary, bang! That's what I need." (ibid., p. 20).

2.4.2 Technology adoption and IS status in New Zealand health care

As is the case internationally, New Zealand is implementing strategies for the electronic management of health information, including programmes targeting greater connectivity of systems, and the security and privacy of health information (Health Information Strategy Steering Committee, 2005; MoH, 2008b; Privacy Commissioner, 2008). The MoH recently led a project to define the key directions for the New Zealand primary care information environment (Creed, 2007; MoH, 2007e) in order to support the Primary Health Care Strategy (King, 2001b). The information environment was defined for New Zealand primary health care as "the collective information capability (people, processes, and technologies) used by all people engaged in the health system to make decisions and act effectively to support the health and wellbeing of themselves, others, and communities" (MoH, 2007e, p. 5). The project found that in its current form, the environment is not adequate to support the goals of the Primary Health Care Strategy (Creed, 2007), due to the fragmented nature of current information systems which render it difficult to deliver the level of individual and population care envisaged in the strategy. The report outlines a strategy for the development of a suitable environment which is currently being followed (Creed, 2007; MoH, 2007e), and the current research seeks to contribute to knowledge in the area through the study of IT sophistication and eCDS utilisation in New Zealand PHOs.

In determining the use of IT by New Zealand GPs, a postal questionnaire survey of all GP practices, with a high response rate of 80%, provided much information (Didham et al., 2004). Practices were asked about their computerisation and technologies, and were found to have a high level of both, with most practices also being able to exchange information electronically with other providers. When compared to international statistics the results demonstrated that New Zealand rates amongst the best developed countries in this respect (ibid.). However, Gillies (2005) outlined the background of computer based support for clinicians and pointed out the slow rate of adoption of CDS technologies, and the current research seeks to explore why this is so.

Potential barriers to successful technology adoption have been identified in both the secondary and primary health care settings in New Zealand. A case study of secondary care paediatric doctors in a New Zealand hospital found that doctors welcomed the use of a CDSS for prescribing (Pain, Fielden, & Shibl, 2003) although three critical areas were identified as important in the adoption of such a system, those being time constraints, limited knowledge, and misreading (Pain et al., 2003). From a pilot study on clinical IT adoption in an urban teaching hospital, Hare, Whitworth, Deek, & Norris, (2006) suggested that data confidentiality and data mobility, are issues which need further exploration, as potentially important barriers. In the primary care sector since 1999, a group of New Zealand researchers have developed a web-based CDSS, initially for CVD risk assessment (Version 1), which has been extended to also include Diabetes risk assessment since 2003 (Version 2), (Wells and Jackson, 2005). Initial evaluation of the CDS programme named PREDICT™, showed promising results which indicated that early adopters had substantially increased the frequency of their risk assessment activities (ibid.). During the evaluation exercise a number of potential barriers to successful adoption of the system were identified including wide differences in practice hardware and software, and varying skills and comfort levels in practitioners' use of CDS programmes. Other important issues surrounded the system's credibility and order of content, and its format, functionality, and adjustability. On-going support from the wider health care organisation, after initial implementation was also found to be important in the continued use of the system (ibid.) Wells et al., (2007) recently published further work on the adoption of PREDICT™. Hunter (1997) also determined critical success factors for the use of EMRs by a group of New Zealand doctors and midwives, and extended the TAM model for application in the health care environment.

2.4.3 Summary of New Zealand HIT research

In New Zealand primary health care, eCDS is provided by a range of technologies including PMS, e-mail, the Internet, and stand alone DSS (Bannink et al., 2006; Engelbrecht et al., 2004a, 2004b; Riddell et al., 2007; Wells, et al., 2007; Whittaker et al., 2006). These systems include tools such as alerts and reminders, diagnostic tools, and evidence based health information (Gillies, 2005). When compared internationally, New Zealand rates amongst the best developed countries in terms of its use of IT by GPs (Didham et al., 2004). However, Gillies (2005) outlining the background of computer based support for clinicians, highlighted the slow rate of adoption of CDS technologies. GPs would value information that was easily available, clear, and concise, supplied by user friendly, reliable sources (Dovey et al., 2006; Gillies, 2005). A number of barriers to the use of CDS tools have been identified, including issues surrounding differences in practice hardware and software, varying practitioner skills, credibility of information and on-going support for continued use of CDS systems (Wells and Jackson, 2005).

In its current form, the New Zealand primary health care information environment is not adequate to support the goals of the Primary Health Care Strategy (Creed, 2007). The

MoH is currently implementing strategies for the electronic management of health information, including programmes targeting greater connectivity of systems, and the security and privacy of health information (Health Information Strategy Steering Committee, 2005; MoH, 2008b; Privacy Commissioner, 2008). Studies of IS and their role in CDS for health professionals working in the recently formed New Zealand PHO environment were not evident during the literature review. More research is therefore needed to support developments in this rapidly evolving environment. Research questions were developed and published research was reviewed to find an approach which would be relevant to the New Zealand primary care information environment and enable the questions to be answered. Work on IT sophistication (Paré and Sicotte, 2001), was considered appropriate to contribute to the current study.

2.4.4 The thesis area: IT sophistication and eCDS adoption in New Zealand PHOs

As the use of IS and eCDS are considered to be important in the development of health care organisations, research considering IS aspects of organisational maturity, innovation readiness, and IT sophistication were considered in the literature review. Reflecting on the literature, further development of the OITIM model (Snyder-Halpern, 2001), and OITIRS scale (Snyder-Halpern, 2002; Snyder and Fields, 2006), would appear to be potentially useful for the estimation of the IT/S innovation readiness of large health care organisations and could form a framework for the construction of a similar model for use in similar organisations in New Zealand. However, although they can be very large, PHOs constitute unique environments, being composed of distinctly separate and individual small organisations, and therefore could react differently from the types of organisations involved in the development of the OITIM and OITIRS. Where the OITIM is primarily concerned with organisational IT/S readiness for innovation associated with, for example, the development of specific hospital systems, the current study of New Zealand PHOs is primarily concerned with the use/adoption of a range of available systems, in particular for CDS. The Maturity Matrix™ developed by Elwyn et al., 2004, also provides an interesting approach to organisational development in primary health care, and includes the consideration of IT although it is not a major component of the model. The Maturity Matrix™ approach (Elwyn et al., 2004) is thorough and could be considered as an approach in future New Zealand primary health care research. However, its approach is wider than the IS focus of the current research.

Technologies with CDS capabilities are complex systems. Their adoption in organisations are influenced by factors including the IT sophistication of the organisation and individuals' responses to the use of IS in general and, as in the focus of this research, to the use of technologies specifically for CDS. After a relatively limited history, research on IT sophistication has recently been stimulated and applied in the secondary health care sector in Canada and the US. This research considers IT sophistication in exploring the domain of eCDS in the New Zealand primary health care information environment. This approach provides comparative measures between case study organisations, and the foundation for a focused study of eCDS utilisation.

Discussing their study of CIS in rural and urban Iowan hospitals, Ward et al. (2006) commented that although their survey instrument had been validated "there is a need to expand beyond this tool to explore further how these systems are used" (p. 436). The current thesis does this by conducting semi-structured, face-to-face interviews with primary health care professionals on their use of systems, particularly for eCDS, in addition to developing and applying a survey instrument based on Paré and Sicotte (2001) in the New Zealand primary care environment. The framework was modified and the survey tool developed specifically for the application in New Zealand PHOs using primary data collected for the purpose.

2.5 Summary of the literature review

The literature review chapter has provided an introduction to the review process and the methodology followed during its course. An overview and plan of the topic areas was provided, followed by the presentation of the review results in three sections, including background information, international research underpinning the research, and a focus on the research area.

Work on the adoption of technologies in health care points to the need for more qualitative studies, and the value of studies using mixed methods. Information on the use of eCDS in its wide sense in health care organisations is limited, often focusing on a particular system and its adoption at the individual level. More research is needed in this subject area in primary health care, at the organisational level, in the New Zealand setting, and taking into account both patient and population level applications.

The review of literature and identification of the research area completes the first stage of the research process described by Bourner (1996) as 'reviewing the field'. With this conclusion to the literature review the report now moves on to the theory building chapter.

3 Theory Building

3.1 Introduction to theory building

The previous chapter fulfilled the first of Bourner's (1996) four steps to successful research 'reviewing the field'. Bourner described the remaining steps as follows:

- Part 2: theory building
- Part 3: theory testing
- Part 4: reflecting and integrating. (ibid p. 7)

The second step 'Theory building' is the subject of this, Chapter 3. In this research it involved taking the information gained from the first step, developing a framework forming the basis of the study, and formulating a research approach. A conceptual model was later developed from the data collected during the research and contributed to the theory building process. Subsequent chapters on research design, data collection and data analysis correspond to the third step of the research process 'theory testing', where the case study method was applied and triangulation used to strengthen the study. Lastly, 'reflecting and integrating' were carried out in the discussion, and conclusions and recommendations of the report, where the research was discussed in relation to other work in the same area and suggestions made for further research.

Theory building can precede or follow data collection and can also emerge "from armchair theorising; introspection; deduction following a review of the literature; personal experience; chance remark; a brainstorm; a fortuitous metaphor; or pure inspiration" (Bourner, 1996, p. 9). In this research theory building both preceded and followed data collection and is described in the following sections.

The chapter begins by presenting the research questions, and moves on to describe the derivation of the framework used in the study. The development of the interview schedule and questionnaire are then described. This is followed by a brief introduction to a conceptual model and five main areas of importance to the subject area, developed from the study, and the chapter summary.

3.2 Research questions

An interest in, and previous research on, the use of IS in New Zealand primary health care, coupled with findings from the literature review, gave rise to the focal question of this research and the development of five research questions which are presented below. The literature review confirmed the drive by international health care providers to improve the effectiveness and efficiency of their services through the provision of integrated IS, including those providing CDS. However, the diffusion of IS in health care has been slow relative to other industries, and there are differences in the technology adoption characteristics of health care professionals. The adoption of eCDS technologies has been particularly slow. Many studies have focused on health care technology adoption by the individual, but research in organisational settings, using more qualitative and mixed method studies are needed.

New Zealand is recognised internationally as having a high level of primary care IS, and has made recent changes to its primary care organisational structure in the formation of PHOs and their focus on population health. This provides an appropriate environment for the study of the information needs, and attitudes to the use of IS, of health care professionals working in a newly created health care organisational structure. The following research questions are therefore posed:

‘What scope is there to improve the use of IS for the support of clinical (population-based and patient-based) decision making by health care professionals working in the PHO environment?’

- How are IS used in the support of clinical decision making by PHO professionals?

- How do IS used for clinical decision support meet PHO professionals information /reporting needs?

- What are the barriers to/what factors influence the use of IS for clinical decision support by PHO professionals?

- What IS useful for decision support are available but not used in the PHO environment?

- How can the use of IS for the support of clinical decision making in PHOs be improved?

3.3 Theoretical Framework

To answer the research questions, a review of the literature provided information including that on aspects of eCDS, and an existing framework of hospital IT sophistication which provided a suitable basis for the development of a similar framework for use in the current research. Following, are definitions for the terms ‘framework’ and ‘model’ as both will be used in this thesis:

Framework:

- A basic conceptual structure (as of ideas); A skeletal, openwork or structural frame. (Merriam-Webster Inc., 2008a)

- A supporting or underlying structure. (Compact Oxford English Dictionary, 2008a)

- A structure for supporting or enclosing something else, especially a skeletal support used as the basis for something being constructed; A fundamental structure, as for a written work; A set of assumptions, concepts, values, and practices that constitutes a way of viewing reality. (Farlex, 2008a)

Model:

- A usually miniature representation of something; A pattern of something to be made; A description or analogy used to help visualize something (as an atom) that cannot be directly observed. (Merriam-Webster Inc., 2008b)

- Something used as an example. (Compact Oxford English Dictionary, 2008b)

- A schematic description of a system, theory, or phenomenon that accounts for its known or inferred properties and may be used for further study of its characteristics…One serving as an example to be imitated or compared… (Farlex, 2008b)

In the current research the IT sophistication framework, proposed by Paré and Sicotte (2001) for application in secondary care organisations, was adapted and developed for use in New Zealand primary care. A conceptual model of eCDS utilisation in New Zealand PHOs was then developed from the research findings, and five areas important for the improvement of eCDS utilisation in PHOs were described. In this way the research questions were answered and theory of the subject area developed.

3.3.1 IT sophistication conceptual framework

To contextualise the use of a range of technologies for CDS, it was necessary to firstly determine the IT infrastructure of the organisations of interest. The framework presented below provided a guideline for assessing the IT sophistication of New Zealand primary health care organisations, in terms of their technologies, functions and systems integration for each of their functional domains. The framework guided the development of the first part of a questionnaire which was used to compare the IT sophistication of the study organisations. The second part of the survey tool concentrated on the use of technologies specifically in CDS. The interview schedule and questionnaire development are discussed in Section 3.3.2

The work of Paré and Sicotte (2001) provided a conceptual framework upon which they constructed a tool for the assessment of IT sophistication in the Canadian hospital system and a diagram of this framework is provided in Chapter 2, Figure 2.2. In the authors' original framework, the dimensions of IT sophistication in the hospital setting are given as technological sophistication, functional sophistication, and integration of systems, determined for each functional domain of the hospital, those being administration, patient management and care, and clinical support. Each functional unit in the hospital was studied with IT being assessed for their amount of usage, computerised activities and processes being identified, and the quality of systems integration being established.

The framework was adapted in the current research for application in the current New Zealand primary health care environment which consists of a range of PHPs, currently mostly GP practices, joined together with PHO-MSs in recently formed organisational structures called PHOs. The framework forms a basis for the construction of an assessment tool. Such a tool can be developed at two levels, being the practice and PHO levels. This thesis employs the practice level framework to develop an assessment tool of IT sophistication in GP practices belonging to New Zealand PHOs. These results combine with interview data from the PHO-MS to provide a PHO level overview. The tool development was achieved with a literature review and an iterative, mixed method pilot case study, and was further developed during two subsequent case studies. Face validity is claimed for the tool, as a result of its comprehensive iterative development with appropriate health care professionals, from which its contents was derived. Future work with a larger number of respondents could include the extension of validation through formal statistical testing.

The conceptual framework, although designed for a hospital setting was considered appropriate for consideration in the primary care setting. This was because the formation of PHOs and the progression towards larger multi-provider practices is creating an environment where there is an increased need for electronic systems integration between different functional units. A diagram is provided in Figure 3.1 to provide a theoretical overview of PHO structure. PHOs vary greatly in their size and structure with the possibility of them eventually encompassing radiology services, and a host of other services such as pharmacy and physiotherapy. It was anticipated that the medium sized PHOs studies in this research would be somewhat limited in structure necessitating the framework, if applied at this level, to be adapted to reflect this. Some of the components in the following illustrations are in dotted outlines to indicate those not anticipated to be present in the study organisations.

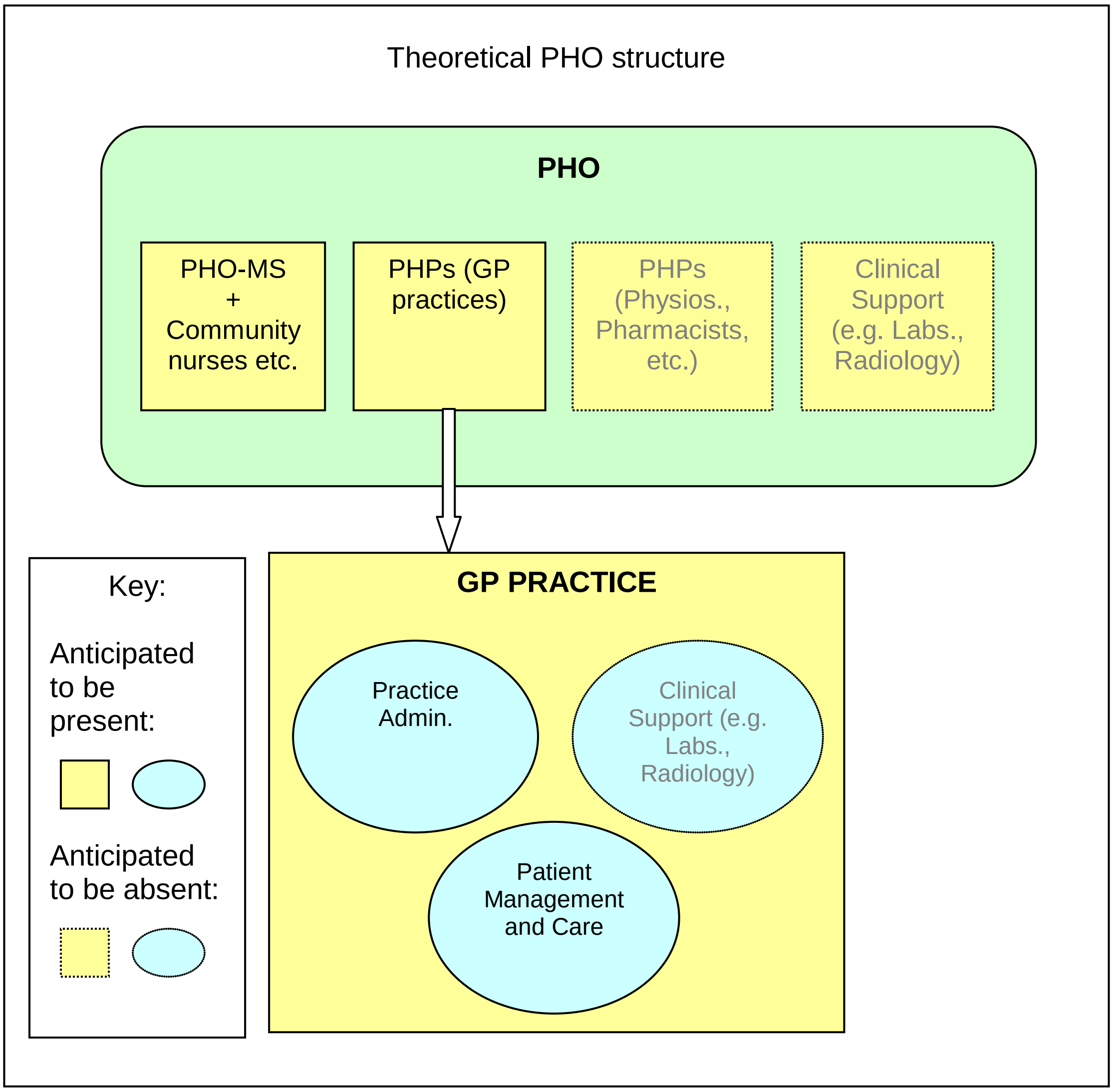

Figure 3.1: Theoretical PHO structure: actual and potential

Currently, many PHOs include GP practices as their only member providers. These practices can vary in size from sole GP practitioners to large practices of many GPs with extensive health care teams, and more such broader scoped multi-service GP practices are envisaged for the future. This means that the sophistication of primary health care IT could increase with additional IT infrastructure and computerised activities, and a greater need for systems integration, within practices, between practices and the PHO-MS, and between the PHO and external systems. Several reasons contributed to the decision to develop the tool at the practice level. Firstly, anecdotal evidence suggested there was a need for PHO-MSs to have a way of determining the IT sophistication of their member practices and have a way of comparing them. Secondly, applying the tool at the PHO-MS level would necessitate the need for aggregate information on member practices, making the chosen approach a natural starting point. Below, are diagrams of the framework based on that of Paré and Sicotte (2001) shown in Figure 2.2, applied at both the PHO level (Figure 3.2), and the practice level (Figure 3.3).

PHO level

Figure 3.2 shows how the framework can be applied at the level of the PHO. To apply the framework at this level, a number of components are included. Administrative activities are carried out by the PHO-MS as are some patient management and care activities. Some of the latter activities are conducted by, for example, community nurses employed or contracted by the PHO-MS. Management of population health issues by the PHO-MS can also be considered to contribute to patient management as decisions made at the PHO level will impact care at the practice level. As mentioned previously, in medium and smaller PHOs, the provider organisations (PHPs) are currently mostly GP practices, which conduct administrative, and patient management and care functions. The range of PHPs is likely to increase with the membership of allied health care providers such as physiotherapists and pharmacists. This also applies to the introduction of laboratories and radiology services which could provide clinical support within the PHO structure. The levels of integration of systems, both within the organisation and with outside entities, is also determined.

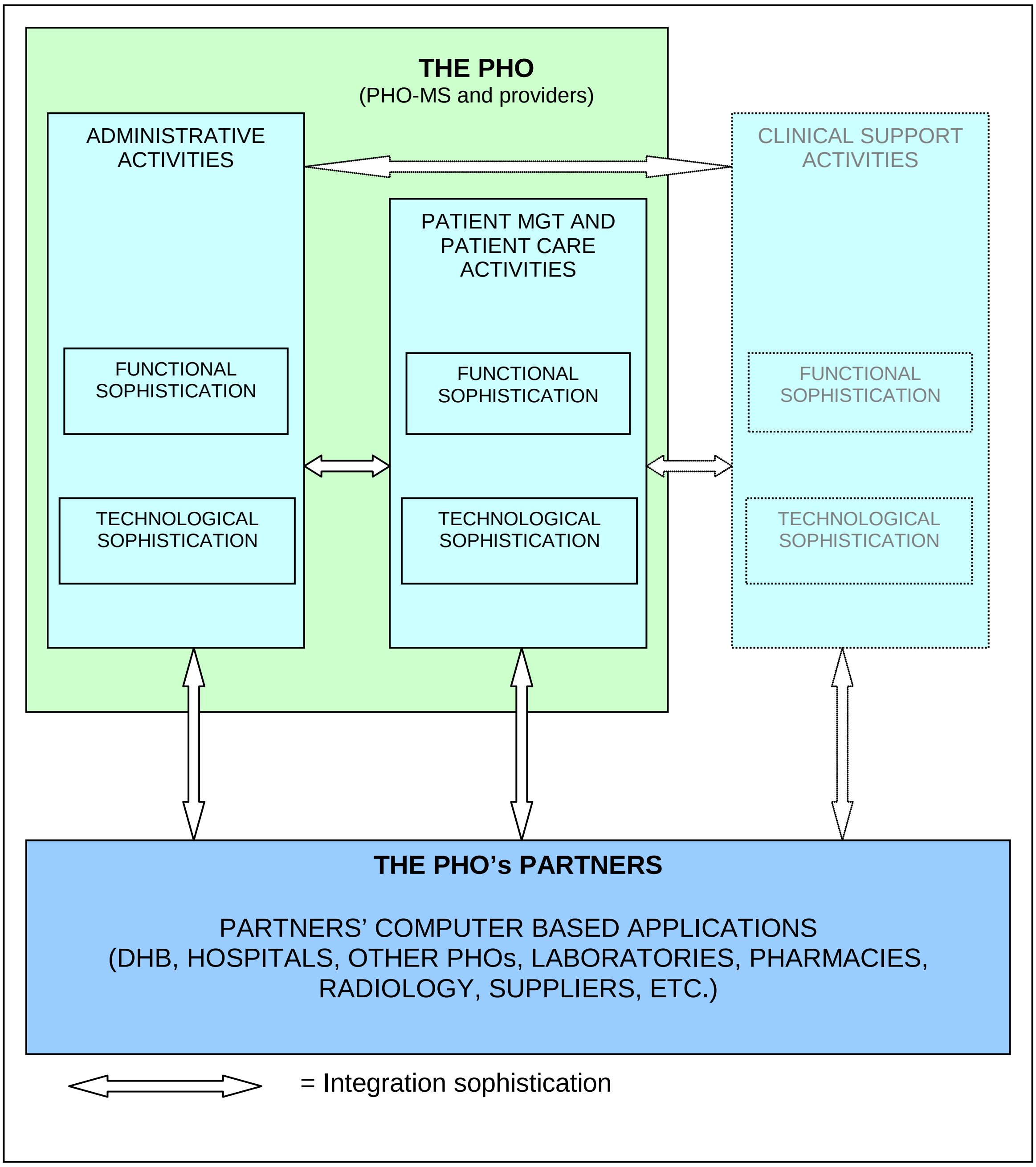

Figure 3.2: Theoretical framework applied at the PHO level (based on Paré and Sicotte, 2001)

Practice level

Having discussed the application of the framework at the PHO level, its application at the PHP level will now be discussed. Figure 3.3 shows how the framework can be applied at the level of the PHP, in this case the GP practice. GP practices conduct both administrative, and patient management and care activities. They can vary in size from those with one practitioner to large multi-care provider organisations, but few, if any, would include clinical support services such as radiology. The use of IT, types of activities which are computerised, and levels of systems integration are determined for the components of the organisation. The level of integration of computer systems is becoming increasingly important with the practice's need to share information electronically with its PHO-MS, and with external entities such as hospitals, laboratories and radiology services.

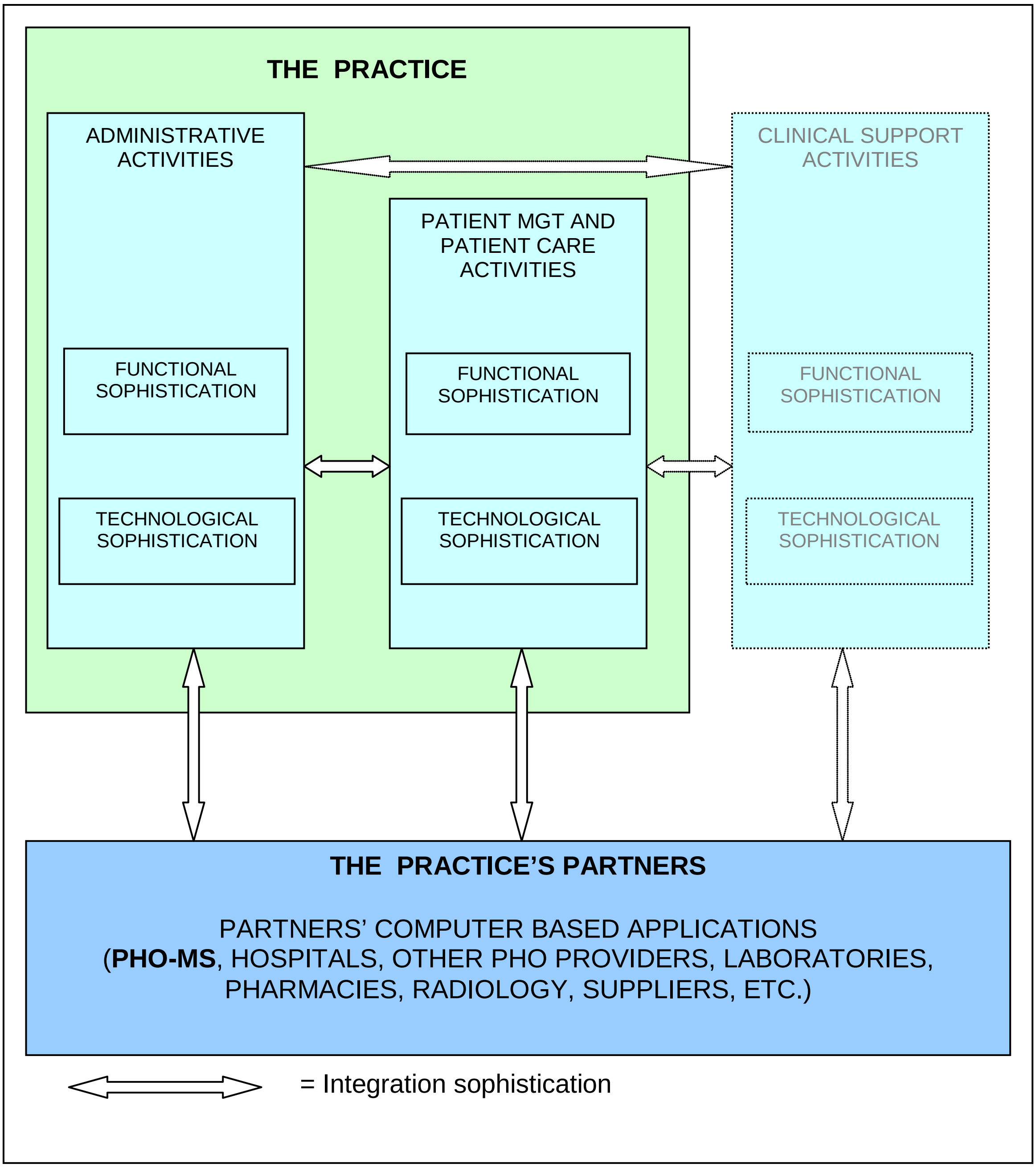

Figure 3.3: Theoretical framework applied at the practice level (based on Paré and Sicotte, 2001)

3.3.2 From theory to assessment: Interview schedule and questionnaire development

The literature review and pilot study contributed to the development of a semi-structured interview schedule (see Appendix 3), to guide the researcher during face-to-face interviews with health care professionals working in PHO-MSs and their contributing GP practices. The interviews were organised to provide in-depth answers to the research questions and to inform the development of the first part of a questionnaire, specifically tailored to New Zealand GP practices operating in the PHO environment, based on the adapted IT sophistication framework shown in Figure 3.3. Based on the framework, the first part of the questionnaire was structured to gather data on the patient management and care, and administrative domains of the practices, in terms of three dimensions of IT sophistication: technological sophistication (range and usage of IS), functional sophistication (range of computerised processes or activities), and integration sophistication (how well systems are integrated within the organisation and with external entities).

The literature review also contributed to the construction of the second part of the questionnaire which concentrated on the use of IS specifically for CDS in the PHO environment. Questions in the second part of the questionnaire which were base on published work are described as follows:

CDS can be provided by a number of sources including embedded programmes, stand alone systems, evidence available via the Internet, or partners' integrated systems. Computer systems which are readily available in the majority of primary care practices, such as the PMS, the Internet and e-mail, provide many of these forms of CDS, although the use of these systems for this type of support is variable (Didham et al., 2004; Engelbrecht et al., 2004a; Western et al., 2001; Western et al., 2003). This work contributed to the following question on the use of the easily available, or popular systems:

> In this practice how much are the following systems used to acquire information to support clinical decision making?
>
> i. Practice Management System (PMS)
> ii. Email
> iii. The Internet

The work of Coiera (2003) and Gillies (2005) provided insight for a question on CDS tools, whilst Metzger and MacDonald (2002) and Kawamoto et al. (2005) did the same for a question on CDS features. Additionally, research by Wells and Jackson, (2005) Johnston et al. (2002) and Short et al. (2004) contributed information for a question on potential barrier to the improved use of IS in CDS.

Coiera (2003) described a number of clinical tasks to which knowledge based, or expert systems could be applied, including:

- alerts and reminders;
- diagnostic assistance;
- therapy critiquing and planning;
- prescribing decision support systems;
- information retrieval;
- and image recognition and interpretation (ibid.).

Similarly, Gillies (2005) described currently available clinical tools as:

- Alerts and reminders, both for efficient time-management and also for recalls of patients for various procedures such as immunisations, etc. Alerts for prescribing are available aimed at reducing the risk of the patient being prescribed incompatible medications.
- Diagnostic tools to assist the clinician at the point of care both in developing an appropriate differential diagnosis, and also in refining the answer by recommending differentiating tests.
- Evidence-based health information in focussed form that is readily available to the clinician at the point of patient contact.
- "Expert" opinions are available especially involving the transmission of data from organ imaging scanning technologies. (ibid., para. 3)

The question developed for the current research from this published work is as follows:

> In this practice how much are the following software tools used to support clinical decision making?
>
> i. Alerts and reminders (e.g. allergies; drug interactions).
> ii. Prescribing decision support (e.g. MIMS).
> iii. Diagnostic assistance/assessment tools (eg. risk calculators/ algorithms).
> iv. Focused evidence-based health information (e.g. Medline, Cochrane).
> v. 'Expert' opinions/systems (e.g. image recognition and interpretation).
> vi. Therapy critiquing and planning (e.g. Clinical Guidelines).

Benefits accessible to primary care practitioners can be expressed in a variety of features/functions (Metzger and MacDonald, 2002; Kawamoto et al., 2005). In a report for the California HealthCare Foundation, Metzger and MacDonald (2002) outlined that decision-support tools could assist physicians by:

- Bringing accessible information and knowledge to the point of clinical decision-making;
- Bringing knowledge *relevant to the particular clinical situation* (for example, the specific patient, the specific issue, or the specific medication) to the physician when needed;
- Combining clinical knowledge with patient information to help the physician stay abreast of the patient's health status (for example, identifying preventative interventions that are due or issues requiring follow-up);
- Identifying patients lost to follow-up or overdue for recommended interventions; and
- alerting the physician to contraindications or potential problems by checking planned actions against other patient information and generally accepted clinical knowledge. (ibid, p. 5)

Also, Kawamoto et al. (2005) identified four features of CDSS which were "predictors of improved clinical practice: automatic provision of decision support as part of clinician workflow…, provision of recommendations rather than just assessments…, provision of decision support at the time and location of decision making…, and computer based decision support…" (ibid. p. 1). The following question encompassed this work:

To what extent do your computer systems provide the following clinical decision support features in this practice?

i. Bring information and knowledge to the point of clinical decision making (decision support delivered at the time and location of decision making).
ii. Provide decision support automatically as part of the workflow.
iii. Provide knowledge relevant to the particular clinical situation (e.g. for a particular patient, issue or medication) when required.
iv. Combine clinical knowledge with patient information to help you keep abreast of the patients health status (e.g. for prevention, intervention or follow-ups).
v. Identify patients lost to follow up or overdue for recommended interventions.
vi. Alert you to contraindications or potential problems by checking planned actions against patient information and generally accepted clinical knowledge.
vii. Provide actionable recommendations.

Barriers to the use of CDS systems were also identified by Johnston et al. (2002), Short et al. (2004), Wells and Jackson (2005), and interviewees of the current research. The information from these sources contributed to the development of the following question on potential barrier to the improved use of IS in CDS:

> This question asks you to what extent there are potential barriers in the following areas, to your improved use of computer systems for the support of clinical decision making in your practice:
>
> i. Cost
> ii. Hardware
> iii. System speed
> iv. Software (in general)
>   a. Format (appearance)
>   b. Functionality
>   c. Content (order, level of detail)
>   d. Flexibility/ease of adjustment
> v. Credibility of information (who is responsible for the decision?)
> vi. Training
> vii. Knowledge of appropriate systems/tools
> viii. Skills/degree of comfort using clinical decision support programmes
> ix. Ability to fully utilise PMS features
> x. On-going systems support
> xi. Time
> xii. Security
> xiii. Privacy
> xiv. Computers being intrusive during consultations
> xv. Reading material on the screen
> xvi. Typing ability
> xvii. Staff resistance

The information detailed above aided the dimensioning of eCDS use in primary care practices and contributed to parts of the interview schedule and questionnaire, which were developed concurrently to maintain alignment of content.

3.4 Model building

Interview data provided in-depth qualitative information specifically about the use of IS for CDS by health professionals working at both the PHO-MS and GP practice levels. Data coding and theme analysis resulted in the emergence of a conceptual model of, and the identification of five main areas of importance to, eCDS utilisation in PHOs. The eCDS Utilisation Model illustrates the variety of levels of eCDS utilisation which can be supported concurrently by a single PHO-MS. The model is illustrated in Figure 7.1, and a full description is provided in Section 7.4. Five areas of importance for the improvement of eCDS utilisation in PHOs are identified and presented, including recommendations, in Section 8.3.1. The interview and survey data together, provided a rich picture of the study area and answers to the research questions.

3.5 Summary of theory building

This section concludes the theory building, second stage of the research process described by Bourner (1996). The chapter presented the research questions and the role of theory in finding answers to them. Following a literature review, an existing framework of IT sophistication was adapted and a survey tool developed through interviews with health professionals, for application in the New Zealand PHO environment. This, formed the first part of a questionnaire, the second part of which concentrated on the use of IS in CDS and was also partly based on published literature. Interviews with health professionals facilitated the full development of both parts of the questionnaire, and the collection of in-depth information on the use of IS in the support of CDM in the organisations studied. Analysis of the data provided rich information on eCDS in PHOs, resulting in a conceptual model of eCDS utilisation in PHOs which is described in Chapter 7, and the description of five areas of importance presented in Chapter 8. The research design will now be addressed in the following chapter.

4 Research Design

4.1 *Introduction to the research design*

This chapter on research design, together with the next two chapters on data collection and data analysis, address activities corresponding to ‘theory testing’, the third of Bourner’s (1996) research process steps. Theory testing can take many forms and employ methods which can be simple or complex e.g. theory testing can simply be a record of the response of the report reader when comparing its conclusions to personal experience, or statistical methods can be used where it is necessary to prove a theory is generalisable when studies have been carried out on a sample of a population (ibid.). The chapter explains the approach taken in the current research and is presented in the following sections: research methodology; case study design; planning and consultation; preparation for data collection; and ethical approval.

4.2 *Research Methodology*

4.2.1 Research philosophy

Researchers have individual opinions and world views which contribute to the positioning of their studies in relation to research paradigms. Hussey and Hussey (1997), state that

> The term paradigm refers to the progress of scientific practice based on people’s philosophies and assumptions about the world and the nature of knowledge…about how research should be conducted.…[Paradigms] offer a framework comprising an accepted set of theories, methods and ways of defining data. (Hussey and Hussey, 1997, p. 47)

Morgan (1979) discusses how the concept of paradigm can be applied at three different levels: the philosophical level; the social level; and the technical level (Morgan, 1979). The philosophical level reflects beliefs about the world; the social level depicts how research should be approached: “… the social organisation of science in terms of schools of thought built around a set of scientific habits connected with particular kinds of scientific achievements” (ibid. p. 137); and the technical level specifies appropriate methods and techniques to be employed (ibid.)

At the philosophical level, two main paradigms forming opposite ends of a continuum can be described, those being positivist, and phenomenological or interpretivist. Other terms such as quantitative and qualitative are often used (Hussey and Hussey, 1997).

However, the pairs are not the same as the latter describe particular methods rather than the overarching research philosophy and will be discussed in Section 4.2.2. Positivist and interpretivist paradigms can be defined by ontological, epistemological, axiological, rhetorical, and methodological assumptions (Creswell,1994; Hussey and Hussey, 1997) and are briefly outlined as follows, together with a description of where the assumptions underlying the current research rest between the two paradigms:

Ontological assumptions are applied to the question of the nature of reality. The extremes of opinion range from positivist beliefs that the world is objective, a singular reality, and separate from the observer, to the interpretivist view of the world as subjective, of multiple realities, socially constructed, and understood by studying peoples' perceptions of phenomena (Creswell,1994; Hussey and Hussey, 1997). The current research sought information on computerised CDS in the PHO environment. The research was partly based on the positivist ontological assumption that the technologies used in the organisations studied were objective in nature, existing independently, and quantifiable. However, it was also based on an interpretivist ontological assumption that the opinions of individuals using those technologies were important in deriving a deeper understanding of their use of those technologies in CDS.

Epistemological assumptions relate to our understanding of knowledge and its validity in terms of the relationship between the researcher and that being studied. Positivist thought suggests an independent, objective perspective where only observable and measurable phenomena are considered to inform valid knowledge. However, interpretivists recognise the interconnectedness of the researcher and the focus of the research (Creswell,1994; Hussey and Hussey, 1997). The current research was partly underpinned by the positivistic epistemological assumption that the observable and measurable component of the research subject provides valuable information on the use of technologies in PHOs, and the use of some of those technologies in CDS. However, it acknowledges the interpretivistic epistemological assumption that factors other than those which are measurable or observable are important in gaining an understanding of the research area, and the researcher recognised the need to personally interview participants to determine these opinions.

Axiological assumptions relate to values, with positivists considering themselves as detached, imparting no influence on their objects of study, and with their scientific approach being value free. Interpretivists, on the other hand, recognise their involvement with that being studied, and that value judgements influence facts and interpretations derived from the research (Creswell,1994; Hussey and Hussey, 1997). The axiological assumptions guiding this research tended towards a positivist perspective, with the intention of determining facts as presented, without the interference of pre-conceived ideas. However, it was acknowledged that information from an interview situation could be influenced by factors such as the level of rapport between the researcher and interviewee, or the way the interview is conducted. Attempts were made to limit such effects and value judgements influencing conclusions on the part of the researcher were avoided. A semi-structured schedule guided the face-to-face interviews, with participants allowed to discuss their opinions freely without strict adherence to the schedule being imposed, recognising the influence of interpretivistic axiological assumptions in parts of the research.

Rhetorical assumptions relate to research language. The positivist approach requires a formal, impersonal language implying objective, rigorous and value free research, whereas interpretivist language is more likely to be informal and personal (Creswell,1994; Hussey and Hussey, 1997). This research report tends to be positivist in its rhetoric as it is a PhD thesis and therefore formal in tone.

Methodological assumptions, which are concerned with the entire research process, evolve from the ontological, epistemological, axiological and rhetorical assumptions described above (Creswell,1994). The positivist end of the methodological spectrum uses a deductive logic where theories and hypotheses are tested. It concentrates on finding ways to measure concepts, or operationalise constructs, large samples are likely to be used, and phenomena reduced to their simplest components. Hypotheses are formed based on objective facts, with analysis focusing on associations and causality. Generalisations are developed to enable predictions and explanations about phenomena, with the validity and reliability of research instruments lending weight to findings. However, the interpretivist approach exhibits inductive logic where categories emerge from the study rather than being suggested earlier by the researcher. Such studies often focus on small samples, sometimes studied longitudinally, with different perceptions of the phenomena provided by a range of research methods, and the analysis directed at ascertaining meaning in a situation and patterns repeated in parallel situations. Verification of information is provided by such means as interaction with informants or triangulation of information sources (Creswell,1994; Hussey and Hussey, 1997). The overall methodological assumptions of the current research tend more towards the interpretivistic than the positivistic, although the application of the framework and quantitative component are positivist in nature exhibiting a deductive logic. The study of a small number of organisations, the triangulation of research methods and information sources, the study of the opinions of individuals, the observation of patterns repeated in the data, and the emergence of the eCDS model and five areas of importance to the utilisation of eCDS in PHOs, are all indicative of an interpretivist approach and inductive logic.

Positivist and interpretivist paradigms were described earlier as opposite ends of a continuum, where research can be placed at any point along the way (Hussey and Hussey, 1997). Philosophical paradigms relating to the epistemology guiding qualitative research have been described as positivist, interpretive and critical (Chua, 1986; Orlikowski and Baroudi, 1991; Myers, 1997, 2008) and it has been argued that the three classifications discussed are not necessarily opposed and could be represented within one study (Myers, 1997, 2008). Myers discusses positivist, interpretive and critical research philosophies, the first two of which have already been outlined. Critical research is involved with social critique. Social reality is considered to be perpetuated by people, some of whom might choose to change their circumstances but are constrained by forces within their society. These restrictive forces are highlighted by critical research, which seeks to eliminate injustices (ibid.). As the current research bears no relationship to the critical research paradigm only positivist and interpretive perspectives have been considered in its description. The current research is based on a blend of interpretivist and positivist assumptions and is largely qualitative with a quantitative component, research methods which are discussed in the following section.

4.2.2 Research methods

4.2.2.1 Qualitative and quantitative research

Myers (1997) describes a research method as "…a strategy of inquiry which moves from the underlying philosophical assumptions to research design and data collection" (ibid., p. 1). The terms quantitative and qualitative are often used to categorise research methods. Myers explains how quantitative research methods originated in the scientific study of natural phenomena, while qualitative research methods were developed in the social sciences to study social and cultural phenomena (ibid.). Quantitative methods utilised in the social sciences include survey methods, experiments, formal methods such as econometrics, and mathematical modelling, while qualitative methods, including action research, case study research and ethnography, derive data from "…observation and participant observation (fieldwork), interviews and questionnaires, documents and texts, and the researcher's impressions and reactions." (ibid. p. 1).

4.2.2.2 IS research approaches

During the 1970's and 1980's differing approaches to research in IS existed, with many US researchers focusing on positivist empirical studies, in contrast to the qualitative interpretive approach of many Europeans (Benbasat and Weber, 1996). Galliers and Land (1987) proposed a taxonomy of IS research approaches, and suggested the need for a wider view to be taken to the study of IS, to that provided by scientific empirical methods. Game/role playing, subjective/argumentative, descriptive/interpretive and action research were included as modes for the newer approaches, and subsequently more methods were introduced. The IS discipline is now established and different research approaches are accepted and respected, although it can still be challenging for IS researchers to gain an understanding of all the different perspectives contributing to IS research (Benbasat and Zmud, 1999).

Concentrating on the qualitative research area, Myers (1997) described how qualitative research methods have become increasingly useful in IS research as managerial and organisational, rather than technological issues, are gaining attention. Myers (1997) distinguishes between the terms qualitative and interpretive, stating that "…qualitative research may or may not be interpretive, depending on the underlying philosophical assumptions of the research." (ibid., p. 1) He goes on to write that "…the choice of a specific qualitative research method (such as the case study method) is independent of the underlying philosophical position adopted" (ibid.). In discussing case study research Yin (2003) explains that case study is a comprehensive research strategy, which should not be confused with "qualitative research" as it can be based on a mix of quantitative and qualitative evidence, or can even be limited exclusively to quantitative evidence, and need not always include direct, detailed observations as a source of evidence.

4.2.2.3 Qualitative IS methods

There are various qualitative research methods which are used in IS research. Myers (1997, 2008) introduces four methods: action research; case study research; ethnography; and grounded theory (ibid.). A brief discussion of ethnography, grounded theory and case study research will now be given as a background to the choice made for this research study.

Firstly, ethnographic research has its origins in anthropology, where researchers often went to live in communities where they could closely study certain phenomena regarding the lives of people, in their social and cultural contexts (Myers 1997, 2008). Ethnography has become an acceptable method for the study of IS in organisations, but still requires researchers to spend a great deal of time in the field. As the current research was carried out in health care organisations, there was no possibility of spending a great length of time observing the study participants in their working environment, particularly in the case of the doctors. Ethical approval for the study was granted for interviews of approximately 1 hour with each participant, and the application of a postal questionnaire.

Secondly, Grounded Theory developed by Glaser and Strauss (1967) is a research method where a systematic, recursive approach is taken to the collection and analysis of data, from which a theory is developed (Glaser & Strauss, 1967; Myers 1997). The method requires the researcher to interact iteratively with the study participants, alternating questions with analysis, refining the process at each stage until a theory emerges. The theory is then said to be grounded in the data. Controversy surrounded the theory with the publication of further work by Strauss and Corbin (1990), and its criticism by Glaser (1992) who felt their work did not represent the original theory developed earlier by Glaser and Strauss (1967). A research approach where multiple sessions with participants were required would not have been appropriate for the environment of the current research. However, in the current study the interviews and their analyses were carried out from as impartial a perspective as possible, and pilot study findings were later observed in the subsequent case studies. By revisiting the data, themes which emerged resulted in the development of a model and the determination of a set of interest areas which could be said to be grounded in that data.

Thirdly, a case study is described by Myers (2008) as both a unit of analysis, as in a case study of a particular organisation, and as a research method. Myers (1997) states that "...the case study research method is particularly well-suited to IS research, since the object of our discipline is the study of information systems in organisations…" (p. 1), and Paré (2002), suggests that case study research is a valuable approach to understanding issues of IT implementation for health informatics researchers. In their 1987 paper, Benbasat et al., provided a useful overview of the application of case study research in IS, discussing a number of case studies and pointing out their strengths and weaknesses. Case studies have been found to be useful in new areas of study and the fast changing IS discipline provides suitable topics for the method (Yin, 2003; Benbasat et al., 1987)

Yin (2003, p. 13) defines the scope of a case study as follows:

> A case study is an empirical inquiry that
> - investigates a contemporary phenomenon within its real-life context, especially when
> - the boundaries between phenomenon and context are not clearly evident.

He further states that:

> The case study enquiry
> - copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
> - relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
> - benefits from the prior development of theoretical propositions to guide data collection and analysis. (ibid., pp. 13-14)

Eisenhardt (1989, p. 534) describes the case study as "a research strategy which focuses on understanding the dynamics present within single settings", and Yin (2003) explains that case studies can be based on single or multiple cases, and can incorporate embedded units of analysis.

In a table summarising features of alternative IS research approaches Galliers (1992, p. 151) describes the case study approach as "An attempt at describing the relationship which exists in reality, usually within a single organisation or organisational grouping". Strengths are given as "Capturing 'reality' in greater detail and analysing more variables" to a greater extent than is possible using e.g. field experiments or surveys (ibid., p. 151). Its weaknesses are described as "Restriction to a single event/ organisation. Difficulty in generalising, given problems of acquiring similar data from a statistically meaningful number of cases. Lack of control of variables. Different interpretations of events by individual researchers/stakeholders" (ibid., p. 151)

4.2.3 Choice of research strategy

The aims and objectives of this research focus on aspects of eCDS used by primary health care professionals in caring for their patients. In New Zealand since 2002, primary health care has been organised in PHOs (MoH, 2007c), and it is in this new management environment that the study is carried out. The creation of PHOs has introduced a population based priority into New Zealand primary health care (King, 2001b). With this comes both opportunities, such as those afforded by an increased knowledge of the state of the patient population, and challenges, such as an increased need for health professionals to collect and share data. Computer based IS are thought to be instrumental in assisting health professionals to make the most of the knowledge resources in their practices and PHOs (WAVE Advisory Board, 2001), and an improved use of CDS by health professionals is being encouraged, both in New Zealand and abroad (Bush, 2004; Department of Health, 2002; NEDST, 2003; WAVE Advisory Board, 2001).

In order to study the use of CDS in Primary Health Care it is necessary to gain an overview of how IS are currently used in general in this area, before focusing on the specific issues of eCDS. Health care organisational structures are highly complex and PHOs are no exception, and because of their newness and individuality, data on ‘typical’ PHO IS usage is not available. Also, the complexity of information they deal with is such that it is difficult for a researcher who is not a health professional to be able to predict the criteria which must be considered in order to find solutions to issues surrounding the use of eCDS in primary health care. Case study was chosen as the research strategy for this project as this researcher is trained in IS, has experience in case study research in primary health care, and due to the newness of the research domain of eCDS in PHOs. The method afforded the ability to gain information which could not have been anticipated before the study, and to enable an effective interview schedule and questionnaire to be developed. In addition to collecting data on the technologies used in the study organisations, the opinions of the users were studied to provide a rich understanding of the use of those technologies, particularly in their utilisation for CDS. The case study research method is a common qualitative method used in IS research and was chosen from other methodologies as being the most suitable to provide answers to the research questions of this project.

4.3 Case study design

The current research involves a study of the use of CDS technologies by health professionals working in PHOs, which are new organisational structures. This, combined with the skill mix of this researcher, suggested that a case study research strategy should be employed. In order to be able to draw both general conclusions and comparisons between different organisations, three PHOs were studied with one contributing to the research as a pilot case study (PHO1) and two further ones (PHOs 2 and 3) adding strength and rigor to the study.

Yin describes five components of research design as being especially important for case studies as follows:

1. A study's questions;
2. its propositions, if any ;
3. its units of analysis;
4. the logic linking the data to the propositions; and
5. the criteria for interpreting the findings. (Yin, 2003a, p. 21)

By addressing these components the researcher will be forced to construct a preliminary theory, which is an essential part of case study design.

> …a good case study investigator should make the effort to develop this theoretical framework, no matter whether the study is to be explanatory, descriptive, or exploratory. The use of theory, in doing case studies, is not only an immense aid in defining the appropriate research design and data collection but also becomes the main vehicle for generalising the results of the case study. (ibid., p. 33)

The five components of research design important for case studies were addressed as follows in the current research:

- **A study's questions**: A set of research questions was developed, see Section 3.2.
- **its proposition:** Case studies of PHOs and their member organisations can reveal information on their use of computerised CDS, and can indicate where there is scope to improve the use of IS for the support of clinical (population-based and patient-based) decision making by health care professionals working in the PHO environment.
- **its units of analysis**: A diagram showing the units of analysis of this multiple case study are shown in Figure 5.1.
- **the logic linking the data to the propositions:** In each of three PHOs data was collected in the following ways. Firstly, Information was collected from individuals with differing roles in the PHO management service. Secondly, information was collected from individuals with differing roles in member practices. Interviews were conducted at three member practices per PHO. A survey tool was developed and applied in the three PHOs. Analysis of the data collected resulted in the identification of themes.
- **the criteria for interpreting the findings:** Research findings were determined through robust research design and the collection of the opinions of individuals providing a variety of perspectives. Data comparison and thematic analysis led

to research findings, and validation of the draft case report was sought from the participating organisations.

Figure 4.1 shows a diagram of the case study method (COSMOS Corporation, as cited in Yin, 2003a, p. 50) adapted to illustrate that used in the current research. In comparing the phases of the diagram to the stages of the current research as outlined by the chapters of the thesis, firstly, ‘define and design’ phase corresponds to theory development and design (Chapters 3 and 4). Secondly, ‘prepare, collect and analyse’ corresponds to data collection and the early stages of analysis (Chapters 5 and 6). Finally, ‘analyse and conclude’ corresponds to the latter stages of analysis, discussion, and conclusions and recommendations (Chapters 6, 7 and 8). The broken arrows illustrate the iterative nature of the current research.

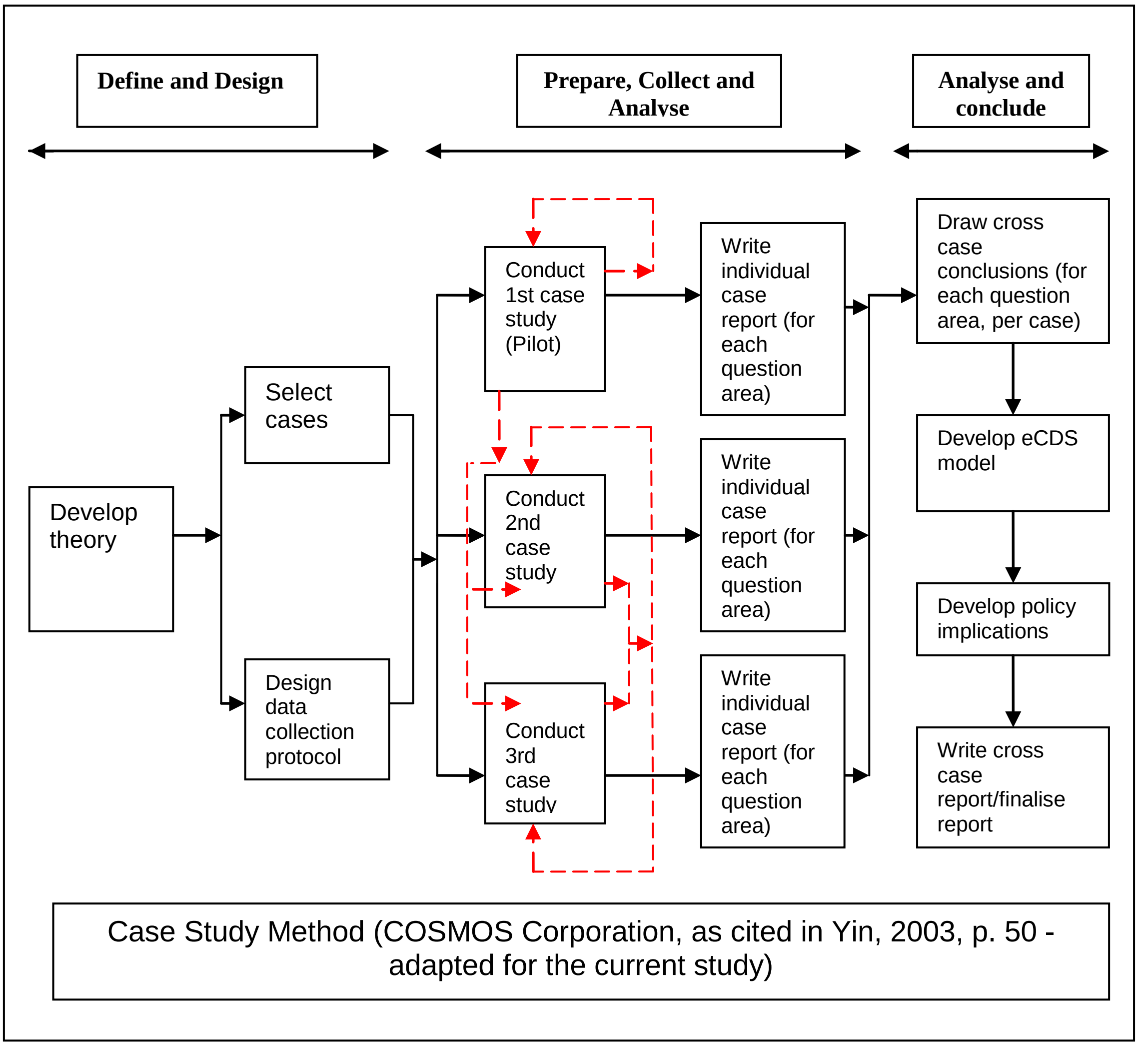

Figure 4.1: Case study method applied to current study (adapted from COSMOS Corporation, in Yin, 2003, p. 50)

4.3.1 Triangulation

Various authors have discussed the importance of using multiple sources of information, known as triangulation, to impart reliability and validity to a study (Denzin, 1989; Patton, 1990; Yin, 2003). Denzin (1989) describes four types of triangulation: data triangulation in which various data sources are used; investigator triangulation, where more than one researcher is involved; theory triangulation, where multiple perspectives are utilised in studying a single data set; and methodological triangulation, whereby different methods are applied to one problem. Of data triangulation Yin (1993) states that:

> The most robust fact may be considered to have been established if three (or more) sources all coincide…ask the same question of different sources of evidence; if all sources point to the same answer, you have successfully triangulated your data. (ibid., p. 69)

The research design of the current study incorporates data and methodological triangulation. Data triangulation was achieved by, firstly, including several PHOs in the study: a pilot study, followed by two other case study PHOs. Secondly, for each PHO, interviews were conducted at the management services organisation and three member GP practices, the latter having been suggested by the PHO management as providing a range practices with respect to IT adoption levels. Thirdly, interviews were conducted with a variety of informants at each of the interview locations. Informants were volunteers suggested by each organisation to provide a range of perspectives. Up to eight PHO management services staff were interviewed for each PHO, and where possible, a doctor, practice nurse and administrator were included for each GP practice. Methodological triangulation was achieved by means of a literature review providing a basis for the development of ideas, and interviews and questionnaires used for data collection, to test theory and provide insight in the study. Where available, documentation from the case study organisations was used to contribute further information and aid in the interpretation of the results, and information on PMSs used by the organisations was obtained from PMS vendors.

4.3.2 Research design quality - validity, reliability and completeness

Paré (2002) encourages a rigorous approach to case study research, to ensure that critics are satisfied that the research is thorough and worthy. Four tests of research design quality are identified (Kidder & Judd,1986, as cited in Yin, 2003) as follows:

- *Construct validity*: establishing correct operational measures for the concepts being studied
- *Internal validity* (for explanatory or causal studies only, and not for descriptive or exploratory studies): establishing a causal relationship, whereby certain

conditions are shown to lead to other conditions, as distinguished from spurious relationships

- *External validity*: establishing the domain to which a study's findings can be generalized
- *Reliability*: demonstrating that the operations of a study – such as the data collection procedures – can be repeated, with the same results. (Yin, 2003, p. 34)

The validity of research relates to how much its findings accurately reflect that which is being studied, and reliability is demonstrated by the reproducibility of the results (Hussey & Hussey, 1997). Construct validity, external validity and reliability are appropriate measures of the current research which is exploratory and descriptive. In the current study the iterative nature of the questionnaire development, and a review of the questions after the pilot study, contributed to construct validity and verification of the framework. Validation of the draft case report by the participating organisations was also sought. This measure was discussed by Yin (2003a p. 159-160) who considers it adds to accuracy and construct validity, and improves the quality of the final study. The process was undertaken by providing the chief executive officers (CEOs) of each participating PHO with Chapters 5-8 together with an executive report and invitation to comment on the draft, before the thesis was completed. Any comments from the CEOs would have been incorporated into the final report where appropriate, but none were forthcoming. External validity, or generalisability, can be demonstrated through the replication of findings in a multiple case study design such as that used in the current study, and reliability was pursued through the thorough documentation of research procedures which would facilitate other researchers to repeat the study, and the development of a case study database as suggested by Yin (2003). Completeness, also discussed by Yin (ibid), was pursued during the pilot study where additional considerations were sought from interviewees and questionnaire participants. During analysis, alternative views were sought for each item explored throughout the study, and this also contributed to completeness in the research. Further discussion of these measures of research quality will be revisited in Chapter 7, in Section 7.2.2 relating to the application of the IT sophistication framework in primary care and the resulting survey tool, and Sections 7.5 1 - 7.5.3 relating to the research as a whole.

4.3.3 Analysis approach

Quantitative data from the postal surveys were entered into MS Exel and analysed using simple proportions. Qualitative interview data was transcribed and entered into QSR NVivo 7 software. This facilitated the categorisation of elements of interest in the material, and the observation of themes in the data. During the analysis of the qualitative data, the emergent themes informed the development of a conceptual model and the identification of five areas of interest which were thus grounded in the data.

4.3.4 Presentation of results

The written product of the qualitative case study material followed a question-and-answer format. Yin (2003a) states that if this format is used for multiple case studies:

> …the advantages are potentially enormous: A reader need only examine the answers to the same question or questions within each case study to begin making cross-case comparisons. Because each reader may be interested in different questions, the entire format facilitates the development of a cross case analysis tailored to the specific interests of its readers… . (ibid p. 148)

The anonymity of research participants was necessary, despite the difficulties of such an approach discussed by Yin (2003), as ethical approval required that the confidentiality of the participants data would be maintained, and that their names would not be used without their permission. Therefore, organisations were not named, individuals were given pseudonyms, and generic job descriptions were used throughout the thesis. In addition to protecting the privacy of participants, the use of pseudonyms in the text enables the reader to distinguish between participants, and the use of generic job titles aids in the alignment of occupation types between organisations.

4.4 Planning and Consultation

The early stages of the research/proposal preparation consisted of selecting a research area of interest, finding a research question, defining the boundaries of the research, and deciding on a research strategy. Having completed these steps, the planning stage consisted of choosing and approaching suitable organisations to study. Also, the need for ethical approval for the research was considered, and a lengthy process was undertaken which culminated with full ethical approval being granted in November 2005. These processes will be discussed fully in following sections.

In New Zealand, intended research processes must be consistent with the provisions of the Treaty of Waitangi. This research sought to be consistent with Article Two of the Treaty of Waitangi by seeking local advice from Te Pūtahi-ā-Toi, School of Māori Studies at Massey University and supervisors/colleagues experienced in Māori research. It recognised that Iwi and Hapu[1] have an authority over their people's involvement in research, and provided for the seeking of consultation with appropriate authorities. The research was consistent with Article Three of the Treaty by seeking to improve the use of IS for CDM in primary health care for the benefit of all New Zealanders. Whilst the aim of the research was not to target differences in IS usage by different groups in the community, any disparities evident in the results were to be explored and reported. Where expectations have been raised regarding the use of IS by PHOs it is hoped that they are able to meet their expectations.

Therefore, prior to the project's development, the consultation process started with supervisors and extended to include discussion with other colleagues experienced in similar work and consultation with Māori, at Te Pūmanawa Hauora, Centre of Māori Health Research and Development, Te Pūtahi-ā-Toi, School of Māori Studies at Massey University, Palmerston North. Consultation with staff at the local Māori health provider, Whakapai Hauora, and the Iwi Council of Elders, Te Mauri O Rangitaane O Manawatu, had been undertaken for a previous study and was continued to include the current research. A presentation to the Iwi Council of Elders was given in July 2005, and a letter indicating their support for the research was received shortly afterwards (see Appendix 2). Staff at an Independent Practice Association (IPA) providing management services for a PHO had been approached, as had their DHB, and discussions entered into regarding their possible interest in the research. A letter of support was also received from the IPA (see Appendix 2).

Although the first PHO approached was very new, its locality and accessibility made it an ideal candidate for a pilot study, the parameters being acceptable as part of the case study approach (Yin, 2003), and interviews and questionnaires were subsequently piloted with that PHO during October and November 2005. At that point letters outlining progress were sent to the other two PHOs together with a request for permission to include them in the study form February 2006 onwards.

Subsequent to the initial planning, consultations were undertaken at regular intervals with supervisors, in order to ensure that the research was progressing successfully.

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[1] An Iwi is a Māori (indigenous people of New Zealand) tribe, the largest social group within Māoridom. Iwi were divided into Hapu (sub-tribe), which in turn are made up of Whanau (households).

4.4.1 Scope of the Research

The scope of this project is limited to PHOs in New Zealand, of medium size (10,000-100,000 enrolled population). More specifically, it concentrates on three PHOs in the Lower North Island. PHO-MS staff, and PHP health professionals and administrators, were interviewed in their workplaces. The questions asked of them concerned their use of IS in support of the caring for their PHOs' patient populations.

4.4.2 Identification of Target Practices

As at least three PHOs were to be studied, various aspects of the range of PHOs were considered including their locations, sizes, length of time established, and funding. The MoH website was used as a source of information on the PHOs. Their locations with respect to both the DHB and Health and Disability Ethics Committee areas were also taken into account. This enabled the PHOs to be grouped into four main areas, those being the Upper and Lower North Island, and the Upper and Lower South Island PHOs.

The lower North Island of New Zealand included a variety of sizes and types of PHO including large urban ones and small rural ones, and also included well established and new organisations (See Appendix 1). As the lower North Island is also the home territory of this researcher, the PHOs of the area held the promise of convenient access and the possibility of being able to benefit from networking with health professionals and organisations with whom previous work had been conducted. This latter point was important as, for example, an ongoing relationship with the local Iwi Council of Elders had been established during earlier research and was greatly valued. Due to the variety of sizes, location types, convenience and accessibility of local organisations it was decided that PHOs in the lower North Island should be approached and invited to participate in the research. However it was decided that the very small PHOs (<5000 patients) would be excluded as the extent of their IS infrastructure would be unlikely to be great enough to contribute to the study.

Contact details for the lower North Island PHOs were obtained from the MoH website and emails were sent to the PHOs to confirm their details. Letters containing an information sheet on the research and a return slip were then sent to the contact persons, asking if they would be interested in further communication regarding their possible participation in the study. From this, four PHOs responded positively, including two which share a common PHO-MS organisation.

4.4.3 Data Gathering Techniques

After deciding on a research strategy, conducting planning and consultation activities, outlining the scope of the research, and selecting the possible target cases, the data gathering techniques were defined. All aspects of the proposed research had to be well defined in the application for ethical approval. Firstly, semi-structured face-to-face interviews were chosen as a main technique as they would allow the researcher to explore answers which could not be anticipated, and encourage interview subjects to answer freely (Attewell and Rule, 1991). An interview schedule was designed as a guide, providing both continuity between interview sessions and a general structure to the interview and analysis processes. Where permission was given by the subjects, the interviews were tape recorded. The time commitment needed on the part of the interviewer, and the organsational aspects of conducting face-to-face interviews with busy health professionals and administrators are disadvantages of this data collection technique. The researcher is indebted to the interviewees at the three case study organisations for arranging interview locations and times to minimise these disadvantages. Secondly, a postal questionnaire was chosen as another main data collection method and developed to provide information from GP practices in each PHO, which had not been involved in face-to-face interviews. By administering a questionnaire to the remaining practices, quantitative information was gathered, providing an alternative data source. Thirdly, data was also collected in the form of documentation provided, where possible, by the participating organisations.

4.5 Preparation for data collection

4.5.1 Development of the Research Tools

The initial question and five research questions developed from it were presented in Section 3.2. These underpinned the development of the semi-structured interview schedule and questionnaire. The evolution of questions for the questionnaire followed a path from guiding questions (or dimensions), via indicators, to the question items. Draft versions of the research tools were prepared to present for ethical approval prior to carrying out the pilot case study. During development of the research questions the decision had been made to use information from the case study interviews to contribute to further development of the postal questionnaire. This necessitated an iterative process of both questionnaire piloting and Ethics Committee approval throughout both the pilot study and the subsequent further two case studies. Following is a summary of the sequence of events:

- Initial questionnaire and semi-structured interview schedule preparation
- Pre-testing the initial questionnaire
- Submission of ethics application including the initial questionnaire (Draft version) and semi-structured interview schedule
- Ethics Committee approval received to carry out pilot case study and further develop the questionnaire
- Pre-test of further developed questionnaire
- Re-submission of questionnaire (Version 1) for ethics approval
- Approval received to apply the questionnaire in the pilot case study
- Information from two further case studies used to refine and finalise the questionnaire
- Submission of finalised questionnaire (Version 2) to the Ethics Committee
- Ethics approval received to apply the finalised questionnaire in the final two case study areas

The questionnaire changed substantially between the three versions as a result of findings from piloting exercises and further review of the literature. Main changes occurred between the draft version and Version 1, where an additional section was added to detail the profile of technologies and their use by the PHO practices, providing the context for the use of CDS technologies in the organisations. This additional section was based on research on IT sophistication (Paré and Sicotte, 2001). After Version 1 was applied in the pilot case study, three respondents were interviewed to gain feedback on the tool, and changes were made in response to these sessions and other testing procedures. The interview schedule was also updated for the main case studies.

4.5.2 Interview schedule preparation

An interview schedule was prepared to assist the researcher during the interviews, and consisted of a collection of open ended questions. The development of the interview schedule and questionnaire were conducted concurrently to ensure the integrity of the two research tools. An MS Excel spreadsheet was used to maintain alignment.

4.5.3 Questionnaire preparation

The questionnaire design process was described by Stone (1993), who suggested that questionnaires should be carefully designed and tested before being used and recommended the following ten steps for developing a questionnaire:

1. Decide what data you need
2. Select items for inclusion

3. Design individual questions
4. Compose wording
5. Design the layout and presentation
6. Think about coding
7. Prepare a first draft and pre-test
8. Pilot and evaluate
9. Perform survey
10. Start again! (ibid., p. 1265)

Initially, eCDS was the entire focus of early questionnaire development efforts. However, after the initial draft version, the questionnaire was developed in two main parts, with eCDS forming the second section of the instrument. A further section was developed and included as the first part of the questionnaire, based on work by Paré and Sicotte (2001). This was designed to examine the IT sophistication of the practices and provide a basis for studying the use of IT for CDS. In this part of the GP practice questionnaire, activities related to patient care were viewed as belonging to one functional unit within the patient management and care domain, rather than separating them according the GP, practice nurse, community nurse and administrator roles within the practice. This compares to the approach taken by Paré and Sicotte (2001) which separates patient care between the functional units of nursing, MD, emergency room, surgery/OR, and patient management. The approach taken in the current research was decided upon because of the close team work in primary care practices, and the common leadership, compared to a hospital situation where functional units are distinctly separate. Similarly, the administrative domain was comprised of practice finance and human resources; facility, equipment and supplies management; and practice wide systems. The format of Paré and Sicotte (2001) was otherwise followed, with the question items being determined from the results of the face-to-face interviews at the case study GP practices. The questionnaire content was therefore specifically developed for New Zealand GP practices and, for example, a question on IT architecture was re-designed and extended to have relevance to the primary health care situation and the PHO environment.

The eCDS section of the Questionnaire (the draft version), was initially submitted to the Massey Human Ethics Committee (MHEC) and the Central Regional Ethics Committee (CREC) along with the applications for approval. The latter committee required some minor adjustments to be made and agreed that, as proposed in the application, further development of the questionnaire should take place during the pilot stage of the study. It was suggested by the CREC member assigned to the application, who was also a GP, that GPs would be more likely to respond to a survey in which the object was clearly understandable and seen to be of value to them, and that the questionnaire could benefit from clarification in some areas, for example by including the meanings of certain acronyms. These suggestions, and information from the pilot study, were incorporated into the questionnaire, and it was at this point that the inclusion of the additional section was decided upon and the questionnaire was developed in two distinct parts. Pre-testing was done with the help of two health professionals, one IT professional and two members of the public, and after a number of minor adjustments the resulting document was re-submitted for ethical approval (see Section 4.6). No further changes were requested by the Ethics Committee and full approval for the study was received, with the proviso that if at any point in the future any changes were made to any documents or planned procedures, the Ethics Committee would be notified and the changes put forward for further approval. Only then was the questionnaire sent out to the GP practices in the pilot case study PHO, for full pilot testing.

After piloting the questionnaire, three willing respondents were contacted and follow up face-to-face interviews conducted, varying in duration from 30 minutes to one hour. Information from these interviews and the completed questionnaires was used to refine the survey tool further. Lastly, information from the remaining two case studies was incorporated into the questionnaire before applying for ethics approval for the final version of the questionnaire.

The draft versions of the questionnaire and interview schedule were included as part of the ethics application. Copies of the finalised questionnaire and the finalised case study interview schedule can be found in Appendix 3.

4.6 Ethics Approval

Obtaining ethical approval for the study was a lengthy procedure which was conducted in four stages. Firstly, approval from the MHEC was sought and this stage of the procedure began with the completion of a screening questionnaire to determine if a full application would need to be made, or if a simple notification would be sufficient. Because the interviewing of PHO staff would take up some of their working time, the committee decided that this would qualify to be described as a use of DHB resources, and advised that a full ethical approval application would need to be lodged. To lodge the application it was necessary provide the committee with the following documents and twelve copies of each:

- Application form and cover sheet;

- Completed screening questionnaire;
- List of publications and presentations/seminars;
- List of references relevant to the research;
- Questionnaire information sheet;
- Questionnaire and return form;
- Interview information sheet;
- Interview schedule;
- Participant consent form;
- Transcriber's confidentiality agreement;
- Confidentiality agreement;
- Authority for the release of tape transcripts;
- PHO recruitment letter, information sheet and return slip;
- Supporting documentation (i.e. from DHB, IPA and pilot PHO).

The application was submitted in late June 2005 to be considered at their meeting in the following month. In order to expedite matters, this researcher attended the committee meeting to answer any questions arising, and was given MHEC approval the next day, pending a few minor changes which were made and approved.

Stage two of the procedure was to apply to a Health and Disability Ethics Committee, and as the target PHOs were in the Lower North Island the appropriate authority was the Central Regional Health and Disability Ethics Committee. The approved MHEC application was submitted to this committee at the end of July. The committee gave provisional approval pending some changes to the questionnaire and information sheets.

Stage three began with a committee member being assigned as a CREC contact person, and discussions were entered into to decide how the questionnaire could be improved. As the initial intention was that the draft questionnaire would be developed further after the pilot case study interviews, permission was granted for that to be done, and for it to undergo a pre-test and then be submitted to the committee for approval before being sent out to the target GP practices. The researcher is grateful for the help provided by the CREC committee member for her helpful suggestions for improvements to the questionnaire. The committee met in November and the questionnaire and other changes were approved at that point and full ethical approval for the study was granted on the understanding that if any documents were changed, if the questionnaire was altered after the pilot case study, or if any other changes not previously indicated were made, the CREC would be informed immediately.

Stage four consisted of contacting the committee with the questionnaire, revised after the pilot case study and interviews with the two case study PHOs, to gain approval to administer it in the latter organisations.

4.7 Summary of the research design

This chapter on research design provided an overview of research approaches including those popularly employed in IS research. The selection of the case study research strategy, and the design of the study were explained. Planning procedures, including consultation regarding the Treaty of Waitangi, the scoping of the research area, and identification of suitable case study practices were discussed. The choice of data gathering techniques, and the preparation of research tools were described, and the chapter concluded with an outline of the ethical approval process. The next chapter describes how the data was collected.

5 Data Collection

5.1 Introduction to the data collection

This chapter introduces the case study organisations and addresses issues surrounding the collection and storage of study data. Having received ethical approval to begin the case studies, key figures at each organisation were contacted to bring them up to date with the progress and arrange a preliminary meeting, in the case of the pilot study PHO, or to clarify their participation in 2006, as in the cases of the two other case study PHOs. After the pilot had been completed and final ethics approval obtained, Case Studies 2 and 3 were arranged. The following sections provide details of the data collection process. Section 5.2 provides the profiles of the three participating case study PHOs, and their member practices taking part in the study. Interview subjects are also introduced. To maintain the privacy of study participants, organisations are not named, individuals are given pseudonyms, and generic job descriptions are provided in this and the following chapters. Section 5.3 describes how the interviews and postal surveys were arranged, and Section 5.4, how the data was collected, handled and analysed.

5.2 Organisation profiles

This section provides demographics of the three PHOs involved in the research, with a brief description of each. PHO-MS staff interviewed for the studies are introduced, and the contributing GP practices are described. Whilst all interviewees were volunteers, efforts were made to include representatives from a variety of roles within each organisation, in order to gather as wide a range of views as possible. PHO-MS interviews were conducted with senior managers and various other managers including those responsible for IT, pharmacist facilitators, and community workers. Practice interviewees included doctors, nurses and administrators, where possible. The details were current at the time of data collection which was 2005 for the pilot case study (PHO 1), and 2006 for the two main cases, PHOs 2 and 3. Figure 5.1 illustrates the case study design.

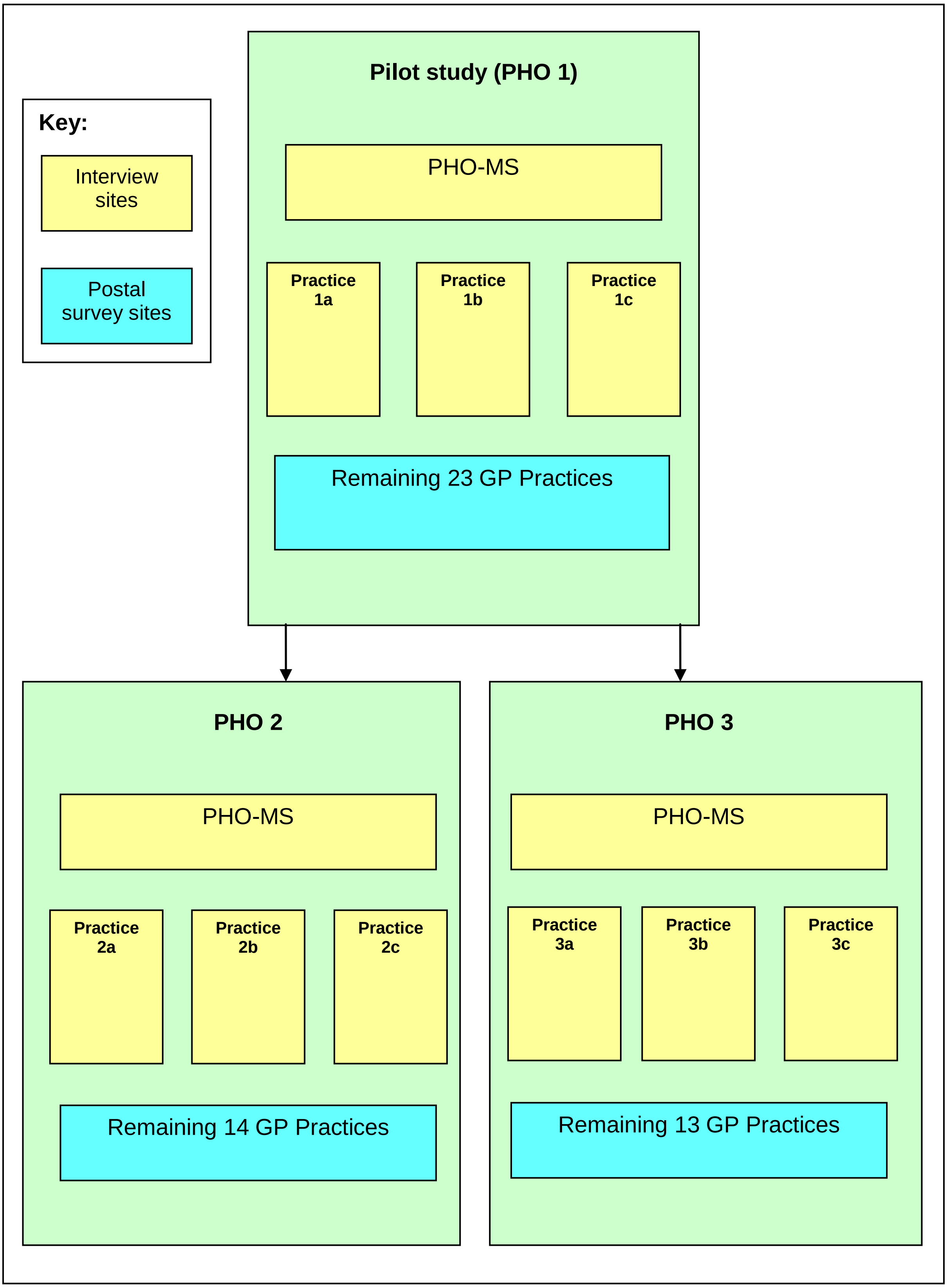

Figure 5.1: Case study design

5.2.1 Pilot case (PHO 1)

The pilot case study PHO had been established only nine months prior to the period of data collection, and was funded under an Interim formula. Its enrolled population numbered approximately 80,000. As a legal entity with no actual employees, its members include 25 GP practices plus a Māori Health Provider, together with a Management Service Organisation (PHO-MS). The majority of member practices were urban, city practices, with only four being based in a rural town. Through a Trust organisation the PHO-MS, which was also an IPA, held full management service contracts for two PHOs, and a partial management service contract for a third PHO. In defining the boundary of the case study PHO, PHO-MS individuals were interviewed to provide information specifically relevant to the single PHO case in question. The PHO-MS general manager was supported by 22 individuals working in the following areas, including four operating off-site for PHOs other than PHO 1. Roles and full time equivalents (FTEs) were as follows:

- Board support - 4 (3.2 FTE, plus 1 FTE vacancy);
- Population health - 3 (2.75 FTE);
- Decision support/data analyst - 1 (1 FTE, plus 1 FTE vacancy);
- Quality care, support and development - 7 (4.05 FTE);
- Business services - 1 (Plus 2 FTE vacancies);
- Human resources - 1 (0.4 FTE);
- Others - 5 (2.6 FTE).

5.2.1.1 PHO 1 Management Service Organisation (PHO-MS):

Eight individuals representing the following roles were interviewed at the PHO-MS: Two senior managers; an IT manager; a pharmacist facilitator; a population health manager; a community nurse; a screening co-ordinator; and a clinical manager.

Three member practices were identified by PHO-MS staff as possible contributors to the study, and which would represent a range of practice types, sizes and IT infrastructure. These practices subsequently agreed to take part in the study and are described as follows:

5.2.1.2 Practice 1.a:

Practice 1.a was a large charitable trust dedicated to the provision of health, social services, education and disability support services to a multi-cultural community of clients. It had been established for 12 years at the time of the study. Although the practice was situated in an urban area, the services provided covered a large physical area including both urban and rural communities. Staff of the organisation numbered approximately 25, including four doctors (1.2 FTEs), two practice nurses, and one receptionist, and an IT systems administrator shared with the wider organisation. Although IT support was under one FTE, additional IT support was also provided as necessary by another staff member.

5.2.1.3 Practice 1.b:

The second practice was an urban GP practice comprising two doctors (1.7 FTEs), two practice nurses (1 FTE) and two administrators (1 FTE). The practice had used a computer in a limited way during the 1990s, but had been fully computerised for five years at the time of the study. IT support was provided partly by one of the doctors and an external company.

5.2.1.4 Practice 1.c:

The third practice was in an urban area, and consisted of a sole GP (1 FTE) supported by two practice nurse (1.5 FTE), an administrator (1 FTE), and a part-time receptionist (<0.5 FTE). The practice had a server equipped with PMS and two further computers linked in a network, but usage of the system was limited to administrative and prescribing functions only.

5.2.2 PHO 2

PHO 2 was a more mature organisation than the pilot case. The PHO had been established for three years at the time of the study, had an enrolled population of approximately 48,000 (MoH, 2005), and was funded under the mixed ‘Interim with Access Practices’ formula. It was comprised of 35 doctors in 17 GP practices, with a PHO-MS. Twelve GP practices were located in an urban setting with the remaining five in rural communities. The PHO-MS was responsible for one PHO, with the following staff roles being identified at the time of the interviews:

- 1 CEO
- 1 Manager (Admin.)
- 1 IT administrator
- 1 Business analyst
- 1 Administrator
- 1 Projects administrator
- 1 Office junior
- 1 Casual receptionist
- 3 Clinical directors
- 1 Clinical co-ordinator

- 2 Pharmacist facilitators
- 1 Clinical projects co-ordinator/DNA co-ordinator
- 1 Health promotion advisor
- 1 Kaiwhakaruruhau
- 1 Practice facilitator
- 2 Immunisation administrators
- 1 Immunisation co-ordinator
- 1 Immunisation support
- 1 Co-ordinator
- 1 PHC nurse leader
- 1 Kaiawhina
- 1 Pasifika nurse
- 1 CarePlus nurse
- 1 High needs nurse
- 1 Social worker
- 5 Counsellors
- 1 Cleaner
- 1 Other

5.2.2.1 PHO 2 Management Service Organisation (PHO-MS):

Five individuals representing the following roles were interviewed at the PHO-MS offices: a senior manager; a manager; an IT manager; a pharmacist facilitator; and a clinical manager.

A list of member GP practices was provided with indications of their IT and size ranges. The following practices agreed to take part in the study:

5.2.2.2 Practice 2.a

The first practice visited in PHO 2 was an urban one with six doctors (five full-time and one part-time), seven full-time practice nurses, and five administrative staff (including three full-time receptionists, plus one full-time and one part-time office manager). The practice had been using a computer for 21 years and had used a PMS for clinical notes since that time. Internal IT was managed by the office manager and one of the doctors, with the PHO-MS providing some support.

5.2.2.3 Practice 2.b

This practice was situated in a rural town and had four doctors, five practice nurses (three permanent and two casual with all being part-time), and four administrators (one full time and three part-time). The practice staff had used a computer for 15 years, but had only computerised patient notes for the last three years. Internal IT support was provided by one of the doctors and the main administrator, with additional external support provided by a private firm. The PHO IT administrator provided some PHO related support.

5.2.2.4 Practice 2.c

The third practice was a remote rural practice, associated with another organisation. The practice consisted of one doctor, one practice nurse, and one receptionist. It had used a PMS for approximately four years, and received IT support through its associated organisation.

5.2.3 PHO 3

PHO 3 was comparable to PHO 2 in several ways. It had been established at the same time, which was three years at the time of data collection, and was also funded under a mixed 'Interim with Access Practices' formula. The PHO was jointly owned by a Māori Development Organisation (MDO) in partnership with a corporation of GPs. A number of providers affiliated to the MDO provide a range of services including nursing, care of the elderly, maternal mental health, mental health, youth transition to employment, public health and economic development with Iwi, Hapu and Whanau. In April 2006, the PHOs enrolled population was approximately 48,000 (PHO Strategic Plan 2006-2009). It comprised 29 doctors in 16 GP practices. Nine GP practices were located in an urban setting with the remaining seven in rural towns. At the time of the study certain data management had been outsourced to an external contractor, but they were about to be managed in house by the MDO partner. PHO-MS roles at the time of the survey were as follows:

- Joint CEOs
- Office administrator
- Operations manager
- Director of nursing – primary health
- Clinical facilitator
- Clinical director
- Service manager – primary health
- Primary health nurse – mobile

- Bus driver project co-ordinator

The MDO partner organisation provided the following:

- IT services
- Māori health advisor
- Financial services
- HR services

5.2.3.1 PHO 3 Management Service Organisation (PHO-MS):

Six individuals representing the following roles were interviewed at the PHO-MS offices: A senior manager; an IT manager; a pharmacist facilitator; a service manager; an operations manager; and a community nurse.

A list of member GP practices was provided by PHO-MS staff during the interview preparation time, with indications of their IT and size range. The following practices agreed to take part in the study:

5.2.3.2 Practice 3.a

This was a large urban practice with five doctors (two full-time and three part-time), seven practice nurses (2.5 FTEs), and three administrators (2.5 FTEs). A PMS had been used for 10 years. There was no internal IT support, but an external company provided support as necessary.

5.2.3.3 Practice 3.b

Practice 3.b was another urban practice with three doctors (2.1 FTEs), two practice nurses (one full-time and one part-time), one practice manager (full-time), and one receptionists (part-time). The practice had utilised a PMS for 13 years and internal IT support was provided by one of the doctors and the practice manager. External IT support for hardware had been provided by a private company but had recently been replaced by support contracted from the PHO-MS.

5.2.3.4 Practice 3.c

This was a small urban practice with one doctor, one practice nurse/manager, and one part-time practice nurse. A PMS had been used at the practice for 15 years although not by the doctor. No internal or external sources of IT support were acknowledged. However, IT support had recently become available if required for a fee through the PHO-MS.

5.3 Arranging interviews

5.3.1 Approaching the pilot case study organisation

The first main meeting with the pilot case study PHO staff was designed to determine the most suitable times to conduct the interviews and provide the PHO staff with information about the research and researcher. A short presentation was given at the PHO management services premises and a light lunch was provided for the staff. Face-to-face interviews with PHO management services staff following in the weeks after this meeting, provided the opportunity to gain information on which practices would be most appropriate to approach for the GP practice interviews. It was decided that three practices representing low, medium and high users of IS would provide the optimal spread of information for the study, and these practices were contacted by email and kindly agreed to participate. Interviews were later conducted with three practices, and a morning or afternoon tea, or light lunch was provided for the practice staff by the researcher, by way of thanks for their involvement. This was also subsequently done for all other practices participating in the study.

5.3.2 Approaching the two main case study organisations

The process of arranging interviews with the subsequent two cases was lengthy due to time and work pressures at the PHO-MSs. A number of letters and emails were exchanged and mutually suitable times organised for the research to proceed. A preliminary meeting was set up with representatives of PHO 2, following a similar procedure to that employed at the pilot organisation. A light lunch was provided for the staff attending the meeting at the organisation’s offices. Background information to the proposed research was provided, together with examples of previous work in the area conducted by the researcher. A time was set for interviews to be carried out at the PHO-MS offices about a month after the initial meeting, and suggestions on the selection of appropriate GP practices were made by the staff at that time. Several practices were contacted by email or letter, and three agreed to participate in the study.

As PHO 3 was located further away from the researcher’s base, arrangements were made for the PHO-MS interviews and the practice interviews to be carried out in the same week, enabling the researcher to stay in the area for the duration of the interviews. The CEO and staff suggested suitable GP practices to contact during the email exchanges, which facilitated the appointment scheduling. Thus the initial physical meeting with the PHO management service team took place on the same day as their interviews, and lunch was once more provided.

The PHO-MS organisations and GP practices were all extremely helpful with the above process, and gave of their time and knowledge in a very generous way. Without their support outlined above the research could not have proceeded.

5.4 Collecting and analysing the data

5.4.1 Conducting the interviews

Interviews were carried out at the case study sites, in rooms provided by the organisation in question. Interviewees were provided with an information sheet and consent form and a verbal introduction to the research was given before the interview commenced. Written notes were taken during the semi-structured face-to-face interviews, and tape recordings were made where permission was given. Hand written notes, tape recordings, and completed questionnaires, were stored securely in accordance with ethics approval requirements.

5.4.2 Conducting the postal survey

The PHO-MSs were most helpful in providing supportive covering letters to accompany the postal questionnaire surveys when they were sent out to the GP practices. The questionnaires were designed as described in Chapters 3 and 4, and packs containing the following were assembled:

- the questionnaire,
- a supporting PHO-MS letter plus one copy,
- a covering letter from the researcher,
- a postage paid return A4 envelope, and
- an information sheet (see Appendix 2).

These questionnaire packs were sent out to all GP practices in the pilot and subsequent two case study PHOs, excluding only those practices which had already taken part in the research by contributing interviews, as it was considered too much of an imposition to request they spend further time answering a postal survey. After approximately four weeks, a follow-up procedure was carried out with the questionnaire packs being sent out again, to non-responding practices, this time including an updated covering letter.

The pilot questionnaire was sent out by mail to 23 of the 26 GP practices belonging to PHO 1. Six questionnaires were completed and returned within the time requested (approximately two weeks) and after a further two weeks another set of questionnaire packs were sent out to non-respondents, with a follow-up covering letter. Ten completed questionnaires were returned in total resulting in a response rate of 43.5%.

When final ethical approval was received the finalised survey tool was sent out to 14 GPs practices in PHO 2 and 13 GP practices in PHO 3. The questionnaire packs were addressed to the administrators of the practices, although the covering letters included suggestions that the questionnaire could be filled out by either the doctor, practice manager or IT co-ordinator, in an attempt to gather information from the person most IT capable in the practice, and also stimulate the best response rate possible. Follow up packs were sent out as in the pilot study. Six questionnaires were returned from each case study PHO, giving a final response rate of 42.9% for PHO 2, and 46.1% for PHO 3. The data is stored in a locked facility in compliance with ethics committee requirements.

5.4.3 Analysing the data

Microsoft Excel software was used for the recording and analysis of data from all completed questionnaires. Qualitative data management began with the transcription of interview data. The quality of the tape recordings was poor for approximately 25% of the interviews, despite the precaution of dual recordings being made of each interview. This was due to a variety of factors such as interruption from background noise and the modulation of interviewees' voices. In some cases one tape was of better quality than the other, due to differences in microphone location. For one interview both recordings failed resulting in the loss of half the data, leaving the hand written notes as the only record for that part of the interview. This highlighted the importance of back-up systems and alternative recording media. Transcription was carried out by the researcher who worked on the more challenging data, and two professional transcribers. However, it was necessary for the researcher to check the work of the transcribers as a number of problems, or 'bloopers' were detected.

Qualitative data handling, including data coding and interrogation, was organised using QSR's NVivo 7 software. The system of tree and free nodes provided a hierarchy of 'containers' for categorising topics and concepts derived from each transcript. Categories, such as particular question areas were assigned to tree nodes. Free nodes were used in 'open coding' (Glaser, 1992) of factors as yet to be categorised, and which were later assigned as child nodes under parent tree nodes where appropriate. Each transcript was coded in this way. The data was then revisited by comparing and querying the contents of the nodes, reflecting on their content, and coding on to further sub-categories or creating new ones where appropriate, as suggested by Richards (2005). These procedures bear some similarity to constant comparison in Grounded Theory Analysis described by Glaser (1992), with data being revisited but without the iteration of data collection. As a result of these activities the grouping of topics/sub-topics and the emergence of themes contributed to model development and the identification of areas of interest leading to a set of recommendations. Findings from the qualitative data analysis are presented in a question and answer format in Section 6.4. A conceptual model is presented in Section 7.4, and a set of recommendations from five areas of interest are provided in Section 8.3.

5.5 Summary of the data collection

This chapter introduced the case study organisations and explained how they were approached. All three PHOs participating in the study were of medium size with enrolled populations of approximately 80,000 for the pilot PHO, and approximately 48,000 each for PHOs 2 and 3. The PHO-MS structures varied but all three provided services for one type of member provider, those being GP practices, and employed clinical providers such as community nurses. Individuals from each PHO-MS organisation and three GP practices form each PHO volunteered to be interviewed. Response rates from the postal surveys were 43.5%, 42.9%, and 46.1% for PHOs 1, 2 and 3 respectively. The procedures undertaken in applying the research methods and collecting the data in these organisations were described in this chapter, and some of the challenges encountered were highlighted. The following chapter concentrates on data analysis and the presentation of results.

6 Data Analysis and findings

6.1 Introduction to the data analysis

Analysis was conducted in several stages due to the iterative nature of the questionnaire development:

- The pilot case study (PHO 1) notes and taped interviews, were analysed to inform the construction of the pilot study questionnaire;
- data from the pilot questionnaire survey were analysed (see Appendix 5). Follow-up interviews were conducted with three survey respondents, contributing to the development and validation of the final questionnaire;
- the notes and taped interviews from the second and third case studies (PHOs 2 and 3), together with the pilot study findings, were used to further refine the final questionnaire (see Appendix 3) which was used to survey GP practices in PHOs 2 and 3;
- questionnaire data from PHOs 2 and 3 were analysed, the results tabulated and findings presented below, and
- qualitative interview data from the pilot study (PHO 1), and subsequent two case studies (PHOs 2 and 3) was transcribed, databased using QSR's NVivo 7 software, analysed and findings presented below. The pilot study interview data was included as it was considered to be rich in information useful for the analysis.

The analysis presented in this chapter begins with a brief comment on the pilot study results in Section 6.2, followed by sections on IT sophistication, and the use of eCDS in the three PHOs studied. In Section 6.3, IT infrastructure in the PHO-MS organisations is reported from interview data, expressed in terms of the IT sophistication framework, and survey results from practices of PHOs 2 and 3 are presented, illustrating the application of the framework at the practice level. This is followed in Section 6.4 by questions relating to the use of eCDS, which are answered using interview and questionnaire data. Interview data from the pilot study (PHO 1) is included with both interview and questionnaire data from PHOs 2 and 3, but questionnaire data from the pilot survey is not included at this point due to differences between the pilot and final survey tools. This section of the analysis is presented in a question and answer format with information from each PHO case followed by cross case analysis, findings, and a summary for each question.

6.2 The pilot study (PHO 1)

The pilot study contributed to the development of the questionnaire survey tool, and information on the use of computerised technologies for CDS throughout the organisation. Data collected from the interviews, and postal survey of GP practices in the pilot PHO, were analysed, and indicated the wide range of usage of technologies available, including ones providing CDS for those practices. A number of barriers to the better utilisation of technologies for CDS were also identified. A sample of pilot study results are included in Appendix 5, some of which have been published (Engelbrecht, Whiddett, & Hunter, 2006; Engelbrecht, Hunter, & Whiddett, 2007a, 2007b).

6.3 IT sophistication

6.3.1 PHO-MS and the IT sophistication framework.

6.3.1.1 Activities

The pilot organisation (PHO 1), and PHOs 2 and 3 were all involved in administrative activities for, and the management and care of, their enrolled populations. Clinical support activities from radiology and laboratory services were provided by external entities for all three PHO, although the potential existed for these to become part of the PHO structure in the future, as could be the case in larger PHOs.

PHO administration spanned a range of activities including financial operations (capitation payments and auditing, processing provider bills and billing, contract management/management of funding streams, budget planning, case costing, and cash management/expenditure and income), governance and board support, and providing statutory legal requirements for entities (annual reports, board meetings etc.), human resource services (employment, payroll, staff scheduling, and workforce development, training and education), internal PHO-MS general office administrative and record keeping tasks, strategic planning, and IT support (for PHO-MS and practices).

Population/patient management activities included those fulfilling the MoH mandate for PHOs to support the provision of primary health care by facilitating a blend of individual and population based approaches, accessible by, and targeting specific health issues for, their enrolled populations. The management of data from a variety of MoH, DHB, PHO contracts, programmes and initiatives, as well as the brokerage and monitoring of associations with other entities e.g. pilot programmes with the ACC or a CDSS developer, formed a large part of PHO-MS activities. The Performance Management

Programme a joint initiative of the DHBs and the MoH, was introduced during the study, in January 2006, and PHOs 2 and 3 were working with their member practices on its implementation by the time their interviews were conducted. Other activities included services to improve access, population health initiatives, health promotion, referred services management, clinical projects and conserved resources management, and cold chain accreditation. Through these activities PHO-MS decided how resources were best allocated in their organisations, influencing decisions on population and patient care in their community and member practices. The feedback of information to PHO community workers and member practices provided some CDS but needed improvement. For example, data collection from practices had increased since they had joined their PHO and the potential existed for them to receive increased and timely feedback in return, but this was still lacking, and community workers often needed improved communications with their base offices.

Population/patient care activities were provided directly by the PHO-MSs via pharmacist facilitator activities or community based projects, or contracts varying between PHOs such as the provision of a community nursing facility, immunisation outreach services, mobile health bus nurses (providing health screening e.g. CV risk assessments, checks and foot care for diabetics, and health promotion advice), or case management through a diabetes nurse educator, or Care Plus, Pacifica, or high needs nurses.

6.3.1.2 Technologies

A range of technologies supported the above mentioned activity areas, and can be found in tabular form in Appendix 4. Most data analysis was being carried out at all three PHO-MSs using software such as MS Excel, and the use of databases such as MS Access was limited, with a need for extra training expressed by some interviewees. However, new data collection and data mining technologies were being implemented at the time of the study with the potential to support the increasing data handling requirements. Whilst all management services used a similar range of technologies, differences in approach to IT infrastructure with respect to the provision of secure messaging systems were witnessed. PHO 2 provided a range of solutions to this requirement which varied according to the distance its member practices were from the PHO-MS base office. This range included fibre optic and microwave networks, with connections to more remote practices awaiting implementation. Commercial solutions, whilst utilised more by the pilot and PHO 3, were considered too expensive for many

PHO 2 practices, and an alternative in-house developed virtual private network (VPN) solution was being planned at the time of the interviews. This was meeting with some resistance from the commercial supplier. In contrast, PHO 3 was funding its practices, initially for a year, to use a secure commercial VPN service.

All three PHO-MSs were implementing new technologies, with the pilot PHO moving from manual collection of quarterly patient register data to collection via data mining client software. This was also being used in PHOs 2 and 3, where a ‘smart form’ technology was also being implemented, and promised to ease data collection. PHO 3 was soon to take part in a CDSS pilot study which would be supported in volunteer practices. The implementation of new technologies appeared to be moving swiftly in terms of the support provided for the practices by their management services. The adoption of these technologies was partly encouraged through voluntariness issues. As the PHO system required increased data handling, member practice teams considered it necessary to keep up with new developments or face difficulties in the future, through workload and/or remuneration issues.

6.3.1.3 Integration

The integration of systems was explored and illustrated that within individual practices systems were mostly networked, with a PMS residing on a central server for access by many staff. Management service organisations were also well integrated, with the exception of community workers who were often without Internet and email connections and in need of better connections to their base offices. However, apart from the use of secure messaging connections, integration between PHO-MSs and their member practices was limited, with even the use of email not being fully adopted.

The need for improved communications was therefore indicated by some within the PHOs studied, between the PHO-MS and their member practices, between practitioners, and also between the PHOs and useful external organisations. Although member practices were well equipped, mostly with networked computers and PMSs, the limited integration with PHO-MSs was an indication that practices varied in the use of their systems, and that the systems were not necessarily being utilised to their full potential. The use of secure messaging services by those practices not using them at the time of the study, the introduction of Internet security systems, and the implementation and adoption of the new data collection and mining technologies, are increasing the integration of systems in the organisations studied.

6.3.2 IT Sophistication in PHO GP practices

The finalised questionnaire survey tool was posted to 14 GPs practices in PHO 2 and 13 GP practices in PHO 3. Six questionnaires were returned from each case study PHO, giving a final response rate of 42.9% for PHO 2, and 46.1% for PHO 3. The data collected, illustrating primary care practice IT sophistication based on the framework described in Figure 3.3, are presented in the following order:

- 6.3.2.1 Demographics
- 6.3.2.2 Patient Management and Care Domain: Functional and technological sophistication:-
    - Practice management systems; extent of records; overall satisfaction with systems
    - Patient management and care processes/activities
    - Patient management and care technologies
- 6.3.2.3 Administrative Domain: Functional and technological sophistication:-
    - Practice finance and human resources
        - Practice finance and human resources processes/activities
        - Practice finance and human resources technologies
    - Facility, equipment and supplies management
        - Facility, equipment and supplies management processes/ activities
        - Facility, equipment and supplies management technologies
    - Practice Wide Systems
        - Practice wide communications technologies
        - Office applications/technologies
- 6.3.2.4 Integration sophistication:-
    - Systems integration
    - IT architecture

Demographic data followed by the results are presented in Tables 6.1 - 6.12. Results are reported as either percentages or mean values of marks from a linear numeric scale where 0 = not at all/not used, 1 = minimally/hardly ever and 7 = extensively/fully used, for Tables 6.2 - 6.11. Result ranges are shown in brackets. The linear numeric scale allows rankings and provides data of equal intervals for statistical analysis (Alreck & Settle, 2004), and differs from the Likert scale which provides ordinal values, although the latter can be adapted to provide interval data (ibid.). Table 6.12 shows results from scale of 1-5 representing increasing magnitude. Missing data (recorded as blanks) were not included in the calculations. As the responses were few, observations of the results are tentative only and no statistical significance is claimed.

6.3.2.1 Demographics

Table 6.1: Practice demographics

	PHO 2 GP practices (n=6)	PHO 3 GP practices (n=6)
Respondents role	33.3% Doctors; 66.7% Administrators.	16.7% Doctors; 83.3% Administrators.
Average number of staff	11.0 (4 - 22)	10.7 (1 - 36)
Average number of doctors (FTE)	3.0 (1 -7)	3.2 (1 - 13)
Average number of nurses (FTE)	3.1 (1 - 7)	2.2 (0 - 7)
Average number of administrators (FTE)	1.8 (1 - 3)	2.8 (0 - 10)
Average number of internal IT staff (FTE)	0.3 (0 - 1)	0.3 (0 - 1)
Average years of regular PMS use	10.1 (4 - 16)	9.2 (1 - 15)
% with IT back-up system	83.3% Yes; 16.7% Blank	100% Yes
% with security plan	66.7% Yes; 33.3% Blank	66.7% Yes; 33.3% No

Demographic data from returned questionnaires is recorded in Table 6.1. The profiles of the two groups of respondents can be seen to be similar.

6.3.2.2 Patient Management and Care Domain: Functional and technological sophistication

Table 6.2: Practice management systems, extent of records and overall satisfaction with systems

	PHO 2	PHO 3
Practice management systems:		
Medtech 32	83.30%	83.30%
Houston VIP	0%	16.70%
Intrahealth Profile for Mac	16.70%	0%
Houston GP	0%	0%
Intrahealth Profile for PC	0%	0%
Next Generation	0%	0%
'Taylor Made Software' Medcen	0%	0%
Other(s)	0% response	0% response
Extent of records:		
Extent of historical patient record computerisation	3.7 (0 - 7)	4.2 (1 - 7)
Extent of current patient record computerisation	5.2 (0 - 7)	6.5 (6 - 7)
Overall satisfaction with systems:		
Extent of satisfaction that the practices computer systems meet its needs	4.5 (0 - 7)	6.0 (4 - 7)

Table 6.2 illustrates that the responding PHO GP practice groups were similar in the number of practices using one vendor's PMS system (83.3%) with each group having one member using an alternative system. The PHO 3 group recorded slightly higher mean scores for the extent of their electronic patient records for both historical and current notes, and appeared to have a higher level of satisfaction with their practice IS.

Table 6.3: Patient management and care processes/activities

Patient management and care processes/activities:	**% of PHO practices with computerised process/activity**	
	PHO 2	**PHO 3**
Patient histories	83.30%	100%
Documenting consultations / clinical notes	83.30%	100%
Screening (e.g. BP)	83.30%	100%
Prescription writing	83.30%	100%
Referrals	83.30%	100%
Recalls	83.30%	100%
Inbox / Outbox	83.30%	100%
Checking lab. test results have been received	83.30%	100%
Classifications (Read Codes)	83.30%	100%
Generating letters	83.30%	100%
Accessing general information	83.30%	100%
Lab. results	83.30%	100%
Appointments	83.30%	83.30%
Decision support (e.g. use of risk assessors, alerts etc.)	83.30%	83.30%
Task List	83.30%	83.30%
Processing paper items/results (e.g. scanning)	83.30%	83.30%
Specialist reports	66.70%	100%
Accessing national registers (NHI; NIR)	66.70%	100%
Obtaining medical information (e.g. travel medicine)	66.70%	100%
Pharmacy information (e.g. MIMs)	66.70%	100%
Patient education (e.g. accessing leaflets)	83.30%	66.70%
Radiology results	50%	100%
Discharge summaries	50%	100%
Patient enquiries	66.70%	66.70%
Managed care contract notes (e.g. Care Plus)	66.70%	66.70%
Staff communications	66.70%	66.70%
Accessing policies and procedures	50%	66.70%
Cold chain management	66.70%	50%
Patient communications (e.g. email; text)	33.30%	83.30%
Coding for care programmes (e.g. sexual health)	33.30%	66.70%
Obtaining Special Authorities	33.30%	50%
Accessing libraries/databases (e.g. through DHB)	33.30%	33.30%
Research projects	16.7%	50%
Other(s)	0% response	0% response

Table 6.3 provides information on the percentage of each group which computerises specific patient management and care processes/activities. The study identified 33 such activities, carried out in practices belonging to medium sized PHOs. The postal survey results showed seven activities where the groups shared similar results, with 24 activities where PHO 2 had a lower percentage, and two (patient education, e.g. accessing leaflets, and cold chain management), where it reported a higher percentage than PHO 3. Only 33.3% of practices in each group appeared to be accessing libraries or databases electronically. The greatest differences between the two groups were noted for patient communications (e.g. email; text), radiology results, and discharge summaries, where PHO 2 reported a lower score for each.

Table 6.4: Patient Management and Care Technologies

Patient management and care technologies:	**Mean values of technology usage by PHO practices**	
	PHO 2	**PHO 3**
PCs	5.5 (0 - 7)	6.8 (6 - 7)
Fax. Machine	5.5 (1 - 7)	6.8 (6 - 7)
Printers	5.5 (0 - 7)	6.7 (5 - 7)
Practice Management System (PMS) e.g. Medtech 32; Houston	5.2 (0 - 7)	7.0 (7 - 7)
Email	5.0 (0 - 7)	6.7 (6 - 7)
Electronic messaging e.g. HealthLink (Lab. results, claiming)	4.8 (0 - 7)	6.8 (7 - 7)
PMS - Electronic results/discharge summary interface	5.0 (0 - 7)	6.5 (5 - 7)
Vaccine fridge data-log software	5.2 (1 - 7)	6.2 (5 - 7)
The Internet / on-line resources (e.g. Medical websites / databases)	4.8 (0 - 7)	5.5 (2 - 7)
Scanners (to scan documents for availability on-line)	5.5 (0 - 7)	4.5 (0 - 7)
RSD (referrals, status reports, and discharge summaries)	3.3 (0 - 7)	6.5 (5 - 7)
Broadband Internet security system (e.g. Securit; Health Express)	3.3 (0 - 7)	5.6 (0 - 7)
PMS - Advanced forms	2.6 (0 - 7)	5.6 (3 - 7)
CV risk assessment software (e.g. Predict ; Bold Promise)	2.0 (0 - 6)	5.0 (0 - 7)
Laptops	2.8 (0 - 6)	4.0 (0 - 7)
Cell phones	3.3 (0 - 7)	3.0 (0 - 7)
PMS - PMS briefcasing	3.2 (0 - 7)	2.3 (0 - 7)
PMS - Patient dashboard	3.4 (0 - 7)	1.3 (0 - 4)
Remote patient monitoring devices (e.g. Heart monitors; BP)	0.5 (0 - 3)	3.8 (0 - 6)
Best Practice decision support system	0.4 (0 - 2)	3.3 (0 - 5)
Computerised Spirometer	2.0 (0 - 5)	1.6 (0 - 5)
Palm-pilots	1.6 (0 - 6)	1.3 (0 - 4)
Remote access (e.g. from home)	0.7 (0 - 4)	1.3 (0 - 5)
Dictaphone for mobile nurse note keeping	0.5 (0 - 3)	1.3 (0 - 5)
ECG interfaced with PMS	0	1.6 (0 - 5)
Digital camera (For mole tracking)	1.3 (0 - 5)	0
Tympanogram interfaced with PMS	0.6 (0 - 3)	0.3 (0 - 1)

Autoclave interfaced with computer	0.5 (0 - 3)	0
Voice recognition software (e.g. Dragon Naturally Speaking)	0	0.5 (0 - 2)
Telemedicine	0	0
Other(s)	0% response	0% response

The use of 30 technologies applied in patient management and care is illustrated in Table 6.4. The group of practices responding from PHO 3 reported a higher use of 20 of the 30 technologies, compared to that reported by the PHO 2 group. Scanners (to scan documents for availability on-line); Patient Dashboard; cell phones; PMS briefcasing; computerised spirometer; palm-pilots; digital camera (for mole tracking); tympanogram interfaced with PMS; autoclave interfaced with computer were used more in PHO 2 with scores ranging from 5.5 down to 0.5 out of a possible score of 7.0, with the last 5 technologies being little used. Telemedicine was not reportedly used by any respondents. Biggest differences were noted in ratings of the use of RSD (referrals, status reports, and discharge summaries); remote patient monitoring devices (e.g. Heart monitors; BP); Advanced Forms; CV risk assessment software (e.g. Predict; Bold Promise); and Best Practice decision support system where point differences ranged from 3.3 down to 2.85.

6.3.2.3 Administrative Domain: Functional and technological sophistication

Practice Finance and Human Resources

Table 6.5: Practice Finance and Human Resources Processes/Activities

Practice finance and human resources processes/ activities:	% of PHO practices with computerised process/activity	
	PHO 2	**PHO 3**
Clinical/prescribing audits	83.30%	100%
Clinical Improvement Indicators (e.g. breast screening)	83.30%	100%
ACC claims	83.30%	100%
Checking addresses for geocoding	83.30%	100%
Reception	83.30%	83.30%
Patient accounts/billing	83.30%	83.30%
Practice accounts	83.30%	83.30%
Collating data (querying)	66.70%	100%
Preparing reports	66.70%	100%
MoH reports (e.g. NIR)	66.70%	100%
HealthPAC claims	66.70%	100%
ACC reports	66.70%	100%
Managed care contracts/progs. (e.g. Care plus)	66.70%	83.30%
PHO reports	66.70%	83.30%

PHO claims	66.70%	83.30%
Communications	50%	83.30%
General enquiries	66.70%	50%
GST	66.70%	50%
Staff schedule	50%	66.70%
Document maintenance (e.g. payments)	66.70%	50%
Practice meetings (re: ethnicities; NHI stats.)	50%	66.70%
DHB reports	50%	50%
DHB claims	50%	50%
Wages	66.70%	33.30%
Personnel files	50%	50%
Banking (Internet)	33.30%	50%
Strategic planning (e.g. with PHO templates)	16.70%	66.70%
Budgeting	50%	33.30%
Clinical staff/locum reports	16.70%	33.30%
Continuing medical education	33.30%	16.70%
Contract maintenance (e.g. nursing; individ.)	16.70%	33.30%
Committee work	33.30%	16.70%
Performance appraisals	16.70%	16.70%
Other(s)	0% response	0% response

The percentages of practices computerising 33 practice finance and human resources processes/activities are shown in Table 6.5. A higher percentage of PHO 2 practices reported having the following seven of these activities computerised: General enquiries; wages; GST; Continuing medical education; Document maintenance (e.g. payments); Committee work; and budgeting. Another seven activities were equally represented by the two groups and included: reception; patient accounts/billing; DHB reports; DHB claims; practice accounts; personnel files; and performance appraisals. Of the remaining 19 activities used by more PHO 3 practices, nine were reportedly used by all the responding practices of that PHO. The greatest difference was reported for ‘strategic planning (e.g. with PHO templates)’ where PHO 3 reported a figure of 66.7% against 16.7% in PHO 2.

Table 6.6: Practice Finance and Human Resources Technologies

Practice finance and human resources technologies:	**Mean values of technology usage by PHO practices**	
	PHO 2	**PHO 3**
PC	5.3 (0 - 7)	6.5 (5 - 7)
Printers	4.8 (0 - 7)	6.8 (6 - 7)
Electronic messaging e.g. HealthLink (Lab. results, claiming)	4.2 (0 - 7)	6.8 (6 - 7)
Electronic claiming	4.0 (0 - 7)	6.7 (5 - 7)
RSD (referrals, status reports, and discharge summaries)	4.0 (0 - 7)	6.6 (5 - 7)
Electronic report receiving	3.7 (0 - 7)	6.8 (6 - 7)

PMS (MedTech 32; Houston etc.)	4.8 (0 - 7)	5.6 (0 - 7)
Electronic reporting	3.8 (0 - 7)	6.5 (5 - 7)
Financial/accounting software (not part of PMS e.g. Quicken; Cash Manager; ACE Payroll; MYOB)	5.0 (0 - 7)	4.7 (0 - 7)
Fax.	4.0 (0 - 7)	4.8 (0 - 7)
Broadband Internet security system (e.g. Securit; Health Express)	3.3 (0 - 7)	5.2 (0 - 7)
Scanner	4.0 (0 - 7)	3.7 (0 - 7)
Data-mining client software from PHO (e.g. LinkTech)	2.5 (0 - 7)	5.2 (0 - 7)
Laptop	3.6 (0 - 7)	2.8 (0 - 7)
PMS financial/accounting package	2.6 (0 - 7)	3.6 (0 - 7)
Remote access (e.g. from home)	0	1.4 (0 - 7)
Other(s)	0% response	0% response

Technologies providing support for practice finance and human resources are listed in Table 6.6, together with their relative usage in the two PHO practice groups. Of the 16 identified, 13 were reported to be used more by PHO 3 practices. The three used more by the other group were laptops, scanners and financial/accounting software (not part of PMS e.g. Quicken; Cash Manager; ACE Payroll; MYOB), although the latter was only marginally used more with only 0.3 difference. The use of scanners was also only slightly different in the two groups by the same figure. The biggest difference was in receiving electronic reports with a difference of 3.1, with PHO 3 reporting the higher score.

Facility, Equipment and Supplies Management

Table 6.7: Facility, Equipment and Supplies Management Processes/Activities

Facility, equipment and supplies management processes/ activities:	**% of PHO practices with computerised process/activity**	
	PHO 2	**PHO 3**
Systems back-up	66.70%	83.30%
Receiving IT support	50%	66.70%
Systems security	16.70%	66.70%
Liaising with PMS vendors / service	16.70%	50%
Purchasing	0%	16.70%
Maintenance organisation (buildings etc.)	16.70%	0%
Other(s)	0% response	0% response

Table 6.7 shows the processes/activities which are computerised for facility, equipment and supplies management at the practices. The greatest difference in the results from the PHO groups' practices for this section, appears to be regarding computerised systems security, where PHO 2 reported a lower level of 16.7% for this item.

Interestingly, when asked if they had a security plan, 66.7% reported positively, suggesting that they were answering generally rather than specifically regarding their IT systems. The same group also used computers less than those in PHO 3 for liaising with PMS vendors/services. Computerised systems back-up, and IT support were also more evident in PHO 3.

Table 6.8: Facility, Equipment and Supplies Management Technologies

Facility, equipment and supplies management technologies:	Mean values of technology usage by PHO practices	
	PHO 2	**PHO 3**
Firewall	5.5 (1 - 7)	5.5 (0 - 7)
Anti-virus software	4.0 (0 - 7)	6.7 (5 - 7)
Security options	4.0 (0 - 7)	6.0 (4 - 7)
Tapes for back-up	4.3 (0 - 7)	4.3 (0 - 7)
Duplicated disc back-up system	3.3 (0 - 7)	4.3 (0 - 7)
Remote access to system by IT equipment vendor	0.7 (0 - 4)	2.7 (0 - 6)
Remote access to system by PMS vendor	0.7 (0 - 4)	0.4 (0 - 2)
Remote access to system by PHO	0.3 (0 - 2)	0.6 (0 - 3)
Other(s)	0% response	0% response

The study identified eight technologies used by practices in the areas of facility, equipment and supplies management, which are shown in Table 6.8. The two PHO groups were similar in their fairly high estimated amount of use of systems back-up tapes and firewalls. The scores reported for remote access to their computer systems, by both their PHO and PMS vendors, were also similar with low ratings from both groups. PHO 3 reported a higher use particularly of anti-virus software, security options, and the remote access to their system by their IT equipment vendor.

Practice Wide Systems

Table 6.9: Practice Wide Communications Technologies

Practice wide communications technologies:	% of PHO practices using the technology	
	PHO 2	**PHO 3**
Broadband	100%	83.30%
Dial-up Internet access	16.70%	16.70%
Fibre optic connections	0%	33.30%
Microwave connections	33.30%	0%
Local Area Network (LAN)	16.70%	0%
Wireless networks	16.70%	0%
ISDN	16.70%	0%
CMS message access	0%	0%
Other(s)	0% response	0% response

Table 6.9 provides information on percentages of practices using the listed practice wide technologies. Broadband was the most used technology with almost all respondents employing it. The greatest difference in the two groups appeared to be in their use of fibre optic connections where a third of PHO 3 practices reported usage, and their use of microwave connections where the reverse was the case. Generally low levels of the other technologies were reported. Out of the eight technologies listed PHO 2 reported only one technology being used by fewer practices than in PHO 3.

Table 6.10: Office Applications/Technologies

Office applications/ technologies:	**Mean values of technology usage by PHO practices**	
	PHO 2	**PHO 3**
Fax. Machines	5.5 (1 - 7)	7.0 (7 - 7)
e-mail	5.2 (0 - 7)	6.7 (5 - 7)
Word processing	4.8 (1 - 7)	5.2 (3 - 7)
Internet browser	5.5 (0 - 7)	4.3 (0 - 7)
Information manager (e.g.MS Outlook)	4.5 (0 - 7)	5.0 (0 - 7)
Voice mail/answer-phone	3.5 (0 - 7)	5.5 (0 - 7)
Internal messaging system	3.7 (0 - 7)	4.5 (2 - 7)
Extranet access (e.g. to ACC)	3.8 (0 - 7)	3.7 (0 - 7)
Spreadsheet (e.g. MS Excel)	3.8 (0 - 7)	3.4 (0 - 7)
CD Burner	1.0 (0 - 3)	3.0 (0 - 7)
Intranet	2.2 (0 - 6)	1.3 (0 - 4)
Project management software	0	3.5 (0 - 7)
Remote access	1.4 (0 - 5)	1.8 (0 - 7)
Intranet access (e.g. to PHO)	2.4 (0 - 7)	0.8 (0 - 4)
Practice Web site	0.8 (0 - 4)	2.3 (0 - 5)
Presentation software (e.g. MS Powerpoint)	2.2 (0 - 5)	0.8 (0 - 3)
Desktop publishing	0.8 (0 - 3)	1.8 (0 - 4)
Database (e.g. MS Access)	0.5 (0 - 2)	1.6 (0 - 5)
Electronic bulletin boards	1.2 (0 - 6)	0
Other(s)	0% response	0% response

The use of 19 office applications/technologies use was presented in Table 6.10. Fax. machines were used most by the practices, with a full score given by PHO 3 practices. This technology was followed by e-mail; word processing software; Internet browsers; information managers (e.g. MS Outlook); and voice mail/answer-phones as the most used. PHO 3 practices reported a higher use of 12 of the technologies, with the biggest difference between the groups evident for project management software, exhibiting a difference of 3.5 points. The smallest difference was for extranet access (e.g. to ACC), where there was only a 0.1 difference in scores.

6.3.2.4 Integration sophistication

Table 6.11: Integration

Integration:	**Mean values of PHO practice IS integration**	
	PHO 2	**PHO 3**
Integration: Practice computer systems with each other (e.g. PMS with office admin. or accounting systems)	3.2 (1 - 7)	4.5 (0 - 7)
Integration: Practice computer systems with similar systems (e.g. PMS used in office with PMS used remotely)	1.8 (0 - 6)	1.4 (0 - 7)
Integration: Practice computer systems with PHO management systems	1.8 (0 - 7)	2.6 (0 - 7)
Integration: Practice computer systems with those of other PHO practices	1.3 (0 - 6)	1.6 (0 - 7)
Integration: Practice computer systems with external systems (e.g. MoH, DHB, ACC etc.)	1.2 (0 - 7)	2.6 (0 - 5)

Scores for the integration of different systems were given in Table 6.11. The integration of practice computer systems with each other rated highest for both PHOs with scores above 3.2. All other scores were fairly low, below 2.6, and similar for both practice groups. The greatest differences in scores between the two groups were seen for the integration of practice computer systems with external systems (e.g. MoH, DHB, ACC etc.), which demonstrated a 1.4 point difference; and practice computer systems with each other (e.g. PMS with office admin. or accounting systems), with a 1.3 difference. However these differences were small and the PHO groups were seen to be very similar for most of the situations. PHO 3 provided the highest scores for integration for 80% of the items.

A two part question based on one of Paré and Sicotte (2001), was developed during the current research for relevance in the primary care situation. Scenarios were developed to represent IT systems architectures of increasing electronic integration, with respondents asked to select one architecture which best described their own for each of two situations, firstly, within their practice, and secondly, between their practice and their PHO-MS. Marks were allotted on a scale of 1-5, where 1 is equivalent to the least, and 5 is equivalent to the most, electronically integrated. The scenarios were as follows:

i) within the practice.

1. **Discreet Manual Systems.** Our systems are manual, paper-based systems.
2. **Discreet Computer Systems.** Our systems are run on stand alone practice computers.
3. **Network (LAN) Based Computer Systems.** We have several computers linked in a network, with each computer containing a different store of data. Accessing data on another computer is possible but may not be easy. Data cannot easily be combined and there is no common database.
4. **Integrated Systems with Independent Modules.** We have several computers linked in a network, with each computer containing a different store of data. There is also a shared database e.g. the PMS, which most users can access, partly integrating the system, but the sharing of different types of data is limited (e.g. patient information and practice financial information).
5. **Totally Integrated System.** Our systems run on a totally integrated practice network where users potentially have access to all data from any computer. There is no duplication of data and functions performed by many different individuals can all be tied together.

ii) between the practice and its PHO-MS.

1. **Discreet Manual Systems.** All information is exchanged using manual, paper-based systems.
2. **Discreet Computer Systems.** Systems are run on stand alone practice, or PHO management service, computers that are not electronically linked.
3. **Network (LAN) Based Computer Systems.** We have several computers linked in a network with the PHO management service, with each computer containing a different store of data. Electronic data exchange between PHO management and practice is possible but may not be easy. Data cannot easily be combined and there is no common database.
4. **Integrated Systems with Independent Modules.** We have several computers linked in a network, with each computer containing a different store of data. There is also a shared database which most users can access, partly integrating the system, but the sharing of different types of data is limited (e.g. patient information and financial information).
5. **Totally Integrated System.** Our systems run on a totally integrated network where users potentially have access to all data from any computer. There is no duplication of data and functions performed by many different health professionals can all be tied together.

Table 6.12: IT architecture

IT architecture:	Mean value of PHO practice IT architecture (Scale of 1-5)	
	PHO 2	PHO 3
IT architecture within practice	3.8 (1 - 5)	4.0 (2 - 5)
IT architecture between practice and PHO management	2.2 (1 - 4)	2.3 (2 - 4)

Table 6.12 presents the results of the question. Mean scores are provided for each of PHOs 2 and 3. Scores for integration of systems within the practices were higher in both practice groups, than those for systems integration between the practices and their PHO management, with fairly close agreement of magnitude between the two groups for both situations.

6.3.3 Summary of analysis of IT sophistication

Information on the use of IS at the PHO-MS level has been gathered and profiles of the use of IS in GP practices have been determined through interviews, the use of the adapted IT sophistication framework and the survey tool developed from it during this research. It is evident that a wide range of technologies are used throughout the study organisations and that GP practices are well equipped with IS. However, the usage of available technologies varies between practices. Having established details of IS use in the PHO environment the focus of the research now moves to an in-depth study of how these technologies are utilised for CDS by PHO-MS and GP practice health professionals.

6.4 eClinical Decision Support

Qualitative results provided by the pilot case study and case studies of PHOs 2 and 3 are presented below. Having established the IT sophistication of the study organisations, the analysis now addresses the research questions focusing the use eCDS in the PHOs. A section of each interview had concentrated on questions relating to IT sophistication and was used to develop part of the questionnaire, whilst questions relating to eCDS had occupied the rest of the interview time. However, issues relevant to eCDS had been raised at a variety of points during each interview, and therefore material from throughout each transcript contributed to this part of the analysis.

A question and answer format has been adopted to present the material in an easily accessible form, enabling the reader to directly access areas of particular interest. The analysis of qualitative data for each PHO case is provided for each question, including that from the pilot case study (PHO 1). The pilot study material is included here for comparison with the two main cases, as its status as a newly formed PHO rendered it a useful comparison to the longer established PHOs 2 and 3 and interesting in itself for the same reason. Each question area is introduced by a background section and concludes with a summary. For the questions within each area, the three individual case reports are provided, followed by a cross case analysis and then a summary of findings. Each analysis includes corresponding quantitative data, where available, from PHOs 2 and 3. This is provided at the end of each cross case analysis section for comparison with the qualitative material. Results are recorded as percentages or mean values of marks from a linear numeric scale of 0-7, where 0 = not at all and 1 is equivalent to minimally/hardly ever. As mentioned in section 6.3.2, observations of the quantitative results are tentative only and no statistical significance can be claimed due to the small number of responses. Quantitative data from the pilot study is not included at this point as many of the results are not in a compatible format to those of PHOs 2 and 3, and some questions were worded differently, or not represented in the pilot survey or vice-versa, due to the refinement of the final research tool. However, extracts from the pilot study findings, have been reported in Appendix 5 and some are referred to in the following passages.

The order and number of questions varies from the first draft interview schedule and reflects the progress of the research through the pilot stage to the final case studies. A copy of the final semi-structured interview schedule can be found in Appendix 3. Question areas 1-4 are ordered below in alignment with the final questionnaire, while results from question area 5 are presented without comparison to quantitative data as this area was not explored in the questionnaire. The order of questions is as follows:

- 6.4.1 Question area 1: Computerised CDS
    - 6.4.1.1 Background to question area 1
    - 6.4.1.2 The use of popular systems:
    - 6.4.1.3 The use of CDS tools:
    - 6.4.1.4 The use of CDS features:
    - 6.4.1.5 Summary of question area 1: Computerised CDS.
- 6.4.2 Question area 2: Information processing requirements
    - 6.4.2.1 Background to question area 2
    - 6.4.2.2 Information Gathering
    - 6.4.2.3 Reporting
    - 6.4.2.4 Information processing needs/data issues

6.4.1 Question area 1: Computerised CDS

In caring for your patients/patient populations, what types of computer support do you use in your decision making?

6.4.1.1 Background to question area 1

Many primary health professionals/managers use computers to assist them in the care of their patients/patient populations. The range of software available means that practices/management have different systems/software and 'tools' available.

The first part of the interview explored the types of software that are used by health professionals/managers when making decisions about patient care, and how they are used. The interviews sought to find out what popular systems, CDS tools, and CDS features are used for decision support by health care professionals/managers, and what their functions are. The responses to this part of the interview contribute answers to the question **'How do PHO health professionals/managers use IS for clinical decision support?'**

6.4.1.2 The use of popular systems:

Computer systems which are readily available in the majority of primary care practices, such as the PMS, the Internet and e-mail, provide many forms of CDS, although their use is variable (Bannink et al., 2006; Engelbrecht et al., 2006; Didham, 2004; Grant et al., 2006; Riddell et al., 2007; Wells et al., 2007; Western et al., 2001; Western et al., 2003; Whittaker et al., 2006). Use of the following systems for CDS is explored in this part of the analysis:

1. Practice Management Systems
2. email
3. the Internet

PHO 1 (pilot) - popular systems:

Practice Management Systems provided eCDS for all the practices where interviews were conducted, although one did not record patients' notes electronically at all, and therefore support was limited at that practice. PMS systems were also used by the PHO-MS in order to design queries for use by the practices and to understand and help to alleviate problems practices were having with their systems. Interviewees were generally very happy with their PMS systems:

> How vital is that? Oh, vital, vital, vital – yeah, I couldn't do without that…I could practice without it but I wouldn't want to…. (GP, Brian)

Email was also instrumental in providing information used to inform CDM for both practice and PHO-MS staff, although some difficulties were expressed. One practice nurse had no email capability on her computer, although it was available to others where she worked, and a doctor at another practice did not use email at all in his practice. Unsolicited email (spam) was found to be particularly annoying by another doctor, who avoided using email as a result. Two PHO-MS staff members commented that more widespread use of email by the practices would make communications within the PHO much easier. One commented:

> …not all general practices have e-mail, and with the palliative care partnership, I sent out a survey to the providers and asked how many would like the manual electronically, and I was very disappointed, only about five percent wanted it electronically. (Clinical manager, Laura)

The need for integration of systems used by different functional groups within primary care was illustrated by a community nurse working under the PHO-MS who expressed a concern that she could not access the Internet whilst working off site, whereas most PHO-MS staff found the Internet was very useful for information acquisition on-site:

> …we do analysis of…drug usage and laboratory testing, and we apply normative guidelines to that and give feedback to the practices in terms of how

> they're performing… …so we use the Internet pretty extensively for getting a lot of that information. (Senior manager, Evan)

Practice staff were also positive about Internet use for helping with such things as finding up-to-date travel information and evidence based medical information, but one practice had no Internet connection, primarily because of security concerns, and not all staff in another practice were provided with Internet access.

PHO 2 - popular systems:

Comments from both PHO-MS staff and practices were widely positive about their PMSs:

> …It's a delightful system, it's just beautiful. Like a Rolls Royce. (GP, Blair)

However, there was a slight criticism from a senior manager who thought the PMS vendors had "been somewhat slow in grasping the needs of the PHO". Also, a practice administrator using a different PMS from the majority in the PHO, was critical of the PHO-MS providing query building support which applied only to the predominant PMS system, indicating the need for different support for her practice.

The use of email as a source of information to provide CDS was positively described by two PHO-MS staff, but was described with a mixed response by practice staff. Whilst it was a source, it was not seen as strongly so, and a lack of access to useful email address lists was mentioned as a problem:

> That's something I would have put back to my perfect system - perfect system would be easy access to people's emails. (Practice nurse, Claire)

The Internet was well regarded as a source of CDS by both PHO management and practice staff and many named favourite sites and the support provided by them.

> …just due to broadband it's actually become quite fun, you know, and prior to that we just didn't - almost never used it really, unless at night when you were trying to find something at home. But it's so quick to get into it now, I can just go quickly across and Google up something and "oh, yeah". I can do it while a patient's here sometimes…. (GP, Blair)

The only negative comments connected to Internet use were from staff of a practice who felt they were disadvantaged as a result of having restricted access to Internet use.

PHO 3 - popular systems:

All PHO management and practice staff were positive about their PMS systems and the value they derive from them for CDS.

> …I go out and 'briefcase', so I take it off site, so I'll go to a rest home and I have all my data with me, which is absolutely marvellous, I must admit. That's one thing I really love about computers, I don't have to take a pile of notes this big with me. (GP, Stewart)

Their reactions were a little mixed when asked about their use of email for CDS purposes. Problems mentioned regarded information overload from too many emails and spam, but both PHO-MS and practice staff were generally positive. One PHO manager emphasised the benefit of being able to communicate quickly with practice staff now that they were becoming "more au fait" with email technology, whilst a doctor illustrated similar advantages in communicating with other clinicians:

> …I had an e-mail dialogue with one of the GPs the other day, to see how it works, and I said "how did you know - you responded very quickly"? and she said, "Well it flashed up on the screen and I just replied between patients"… …They [the practices] often ring or e-mail, or send a query by e-mail. (PHO-MS pharmacist facilitator, Chris)

> I had a patient just recently that I vaguely remembered some condition that a neurologist had told me about at a conference, and I was able to e-mail her in Auckland, and she was able to e-mail back and say "yes, that it was it, and this is what you do". (GP, Stewart)

The Internet was well thought of for providing CDS by both PHO-MS and practice staff interviewed:

> …it had up-to-date information, especially the websites - they had up-to-date information day by day, and…it was good…to be able to print out for patients who were travelling overseas. (Practice nurse, Sylvia)

The only slightly negative statement was related to time resource issues and came from a doctor who does not use the Internet at work but will follow up questions at home when he has time, and went on to name some of his favourite sites.

Cross case analysis - popular systems:

All three popular technologies, those being PMSs, email and the Internet were found to be used by PHO management and practice staff in the pilot (PHO 1), and PHOs 2 and 3, to provide them with information useful in supporting CDM. Many practices utilised their PMSs well, but there were still some where limited use was made of existing systems. Email was found to be useful, but its use was also variable. Simple problems such as a lack of useful e-mail address lists seemed to be an issue in PHO 2 as in the pilot study, which also indicated a lack of practice use of e-mail and problems with spam. The latter problem, and information overload were both present in PHO 3. More PHO 3 practice staff were positive about the benefits of e-mail than those of PHO 2. The Internet was well regarded for CDS in all cases, with the only negative comments being from a doctor in PHO 3 who felt he did not have time to use it during practice hours but who also did not use a PMS for patient notes, a community nurse who had no Internet access whilst working off site for the pilot PHO, and a practice where limited access was a problem in PHO 2. Thus variability was also evident in the use of the Internet in CDS. The latter two situations illustrated the need of some primary care professionals for improved systems' integration.

The quantitative results for the use of popular systems for CDS (Table 6.13), showed the use of all three popular technologies in CDS by practices in PHOs 2 and 3. The PMS scored highest in both PHOs. Generally higher figures were reported for PHO 3, possibly indicating that the responding practices felt they were deriving a greater level of CDS from popular systems than those in PHO 2. The results for e-mail were particularly widely spread, with PHO 3 practices giving a higher rating for e-mail than the Internet, and the reverse given by PHO 2 for those two items. When compared to results for the general use of popular systems in patient management and care, also shown in Table 6.13, it can be seen that in both PHOs the figures are lower for all systems for CDS use, with PHO 3 again recording higher scores than PHO 2.

Table 6.13: Questionnaire results for question 1 – popular systems

Questionnaire data relating to question area 1 (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally, and 7 = extensively)		
Use of Popular Systems for Clinical Decision Support		
Technology:	**PHO 2**	**PHO 3**
PMS	4.8 (0 - 7)	5.8 (1 - 7)
The Internet	4.0 (0 - 5)	4.4 (2 - 7)
Email	2.5 (0 - 5)	5.2 (4 - 7)
Use of Popular Systems in Patient Management and Care (see Table 6.4)		
Technology:	**PHO 2**	**PHO 3**
Practice Management System (PMS) e.g. Medtech 32; Houston	5.2 (0 - 7)	7.0 (7 - 7)
The Internet / on-line resources (e.g. Medical websites / databases	4.8 (0 - 7)	5.5 (2 - 7)
Email	5.0 (0 - 7)	6.7 (6 - 7)

The results echo those from the pilot study (Appendix 5, Section 10.5.1) which showed that only a proportion of practices in PHO 1 were using their available technologies for

CDS (Engelbrecht et al., 2007a, 2007b). The systems used for CDS and the extent of their usage by practices within the pilot study PHO varied greatly, with increasing practice size appearing to favour CDS use (Engelbrecht et al., 2006). However, practice size did not seem to be an important factor with respect to IS infrastructure (Engelbrecht et al., 2007a, 2007b).

'Popular systems' findings

The study determined that the PMS, email, and the Internet are being used for a range of activities, including CDS in its wide sense, by individuals in differing roles within the organisations. Individual practice use of the technologies was found to be variable, as was observed in the pilot study (Engelbrecht et al., 2006, 2007a, 2007b). Utilisation of PMSs, the Internet, and email for CDS varied from none at all (by a respondent to the postal questionnaire), to a level where the three technologies were well used, contributing to CDS for staff at practice and management levels. A number of issues found to surround the use of popular systems are listed below:

PMS:

- Those practices using a PMS not predominant in the organisation needed more support with, for example, querying the database.
- Practices which had resisted changing their PMS system to align with the majority in the group, had individual reasons for not changing. For example, the practice owner might fear the loss of a valued staff member, fearful of a system change, or cost issues might be important.
- Typing issues caused limitations to several practitioners, including problems from Occupational Overuse Syndrome, and lack of typing speed. The latter issue was cited as having the potential to impact the quality of notes taken, possibly even to the extent of reducing their legal standing.
- Some users felt that PMS software developers were slow to respond to user requirements.
- The need for on-going personal support was signalled and will be discusses elsewhere.

Email:

- Some practices were not using email.
- Not all staff were connected to email within some practices, and some off-site or community workers also lacked access to email.

- Useful e-mail address lists were often not accessible.
- Information overload, and spam were a problem to many.

The Internet:

- In some organisations Internet access was not available to all staff e.g. nurses.
- Staff working off-site or in the community often had no Internet connections.
- Many individuals had time limitations and expressed a need for assistance with search techniques.

6.4.1.3 The use of CDS tools:

Computerised CDS tools assist individuals by providing support for CDM, and include stand alone systems, and software embedded in other multi-function systems. A list of such tools based on Coiera (2003) and Gillies (2005) is as follows:

1. Alerts and reminders (e.g. allergies; drug interactions).
2. Prescribing decision support (e.g. MIMS).
3. Diagnostic assistance/assessment tools (e.g. risk calculators/ algorithms).
4. Focused evidence-based health information (e.g. Medline, Cochrane).
5. 'Expert' opinions/systems (e.g. image recognition and interpretation).
6. Therapy critiquing and planning (e.g. Clinical Guidelines).

PHO 1 (pilot) – CDS tools:

The pilot PHO interview data showed that Tool 1 ‘Alerts and reminders’, were used by all PHO-MS and practice staff who were asked to comment about that item. The practice staff, and community nurses employed by the PHO, received CDS through their PMS systems using this tool. Additionally some PHO-MS staff used other forms of alerts and reminders e.g. through MS Outlook and the PHO intranet etc., to aid their work in making decisions about projects, therefore receiving support for CDM in the PHO through those tools:

> I only yesterday set up so that I get alerts when there is new stuff on there [the intranet], so that I know I need to go and look on there, and I am sure that will be useful in the future. (Screening co-ordinator, Karen)

Tool 3 ‘Diagnostic assistance/assessment tools’ were used by some of both the management services and practice staff, as was Tool 4 ‘Focused evidence-based health information’:

> …we are very, very lucky in this region that the local clinical library is funded by the DHB to provide a service free of charge to primary health providers… …well

> we've got direct access to some of their databases in fact, a remote access…. (Pharmacist Facilitator, Barry)

No evidence was found for the use of Tool 5, ''Expert' opinions/systems', in terms of automated systems, although the use of electronic communications channels for consulting experts in various fields was frequently discussed. MIMS was described as a system based on "proven specialist advice" by one GP, and was used as an example in the pilot questionnaire. The interviews showed that MIMS was used by some PHO-MS employees and practice staff, providing prescribing support, and the high score derived for this tool in the postal survey was thought to be largely due to respondents' use of MIMS. As a result, the list of tools was clarified for its application in the final case studies with 'Prescription decision support (e.g. MIMS)' being added as a separate item in the final questionnaire as Tool 2. No evidence for the use of systems assisting in therapy critiquing or planning was determined from the interviews.

PHO 2 - CDS tools:

Tool 1 'Alerts and reminders' were used by three of the four practice staff interviewed, but a pharmacist facilitator employed by the PHO-MS organisation highlighted the difficulties both she and many doctors experienced with alerts provided by her system's prescribing support, resulting in her limited use of the tool:

> The interaction alerts that are in that system are totally over the top……I know doctors switch them off …there's so many of them that they've just kind of numbed them to the importance of drug interactions, so - then that kind of makes my work harder, if you like, because when you start talking about drug interactions they all go "Oh…they're not relevant"…. (Pharmacist facilitator, Helen)

Tool 6 'Therapy critiquing and planning' was discussed by practice interviewees, with it being considered a welcome development for the near future:

> We get a lot of data, like, a lot of guidelines, from the Department of Health…quite complex guidelines - but you have so many that you can't get it, so…with these new [smart form] things you can actually…build one that'll take you through the clinical decision process, record your data, and it makes things a whole lot easier. (GP, Ian)

Tool 5 ''Expert' opinions/systems did not seem to be used by PHO-MS or practice staff in its purely automated sense, and questions on the remaining two tools 'Focused evidence-based health information', and 'Diagnostic assistance/assessment tools', provided a mixed response from both PHO-MS and practice staff. The following comments from a doctor explained his reluctance in using the latter CDS tool:

> I'm not big on algorithms at the best of times, and while I recognise that there are - they do have their place, I don't know that I would utilise them any more just 'cos they were on my computer…I think they also take away, or they have the potential to take away common sense and, sort of, perhaps clinical experience…sort of a human factor I guess…and, I mean, there are areas where science with algorithms has a very strong place. There are other areas where the sort of - the art of medicine, if you like, is perhaps more important, and I think that particularly in general practice - and I think of general practice…is…perhaps different to some other areas in medicine - quite often - and it may be some workers would suggest that maybe 60% of the time there isn't actually a specific diagnosis, so you know, your algorithms aren't going to help in that regard…. (GP, Ross)

PHO 3 - CDS tools:

A service manager outlined some initiatives of the PHO which would increase eCDS, including in the areas of therapy critique and planning, for the practices and PHO-MS. These incentives included the purchase of licences for a smart form technology and committing to the purchase of a new patient health status interface, both for their predominant PMS, which would be funded by the PHO-MS for the practices, to provide functionality and efficiencies for them all. Of the new interface she commented:

> …[it] uses smart form technology, but it collates specific things of interest to the practice team as well as to us…We're purchasing the tool for efficiencies…it brings everything into one screen, that you're interested in, making sure you've done for this person. It makes it visible…. (Service manager, Sally)

The trial of a new CDS system was also being organised at the time of the interview and one GP spoke of his interest in a similar system being developed and trialled in another PHO, which could provide support for therapy planning. Tool 1 'Alerts and reminders', was widely used by practice staff. Tool 2 'Prescribing decision support', was used by many practices and a PHO staff member, but was often described as being a source of information overload. Tools 3 and 4, 'Diagnostic assistance/ assessment tools', and 'Focused evidence-based health information', were used by both management and practice staff, although not all practice staff found them useful, and tool 5 ''Expert' opinions/systems' were not found to be used by anyone interviewed.

Cross case analysis - CDS tools:

No evidence was found for the use of automated 'Therapy critiquing and planning', or 'Expert opinions/systems' during PHO 1 interviews, with the high score derived for the latter tool in the pilot postal survey thought to be largely due to respondents' use of prescribing support provided through the PMS, also found to be utilised by pilot study management staff. 'Prescription support' was therefore added as a separate item in the final questionnaire as Tool 2. Similarly, there was no data available from PHO 2 management staff on 'Therapy critiquing and planning', and the use of 'Expert' opinions/systems' was not evident from interviews in either PHOs 2 or 3. Evidence of the use of all other items was received from both PHO-MS and practice staff in all three PHOs. PHOs 2 and 3 interviews indicated at least one, and mostly several practices were using the tools. PHO 2 had more PHO-MS staff reporting the use of 'Focused evidence-based health information', whilst PHO 3 had more reports of the use of Tool 3 'Diagnostic assistance/assessment tools' by PHO-MS staff. The introduction of systems providing properties relating to 'Therapy critiquing and planning', were being newly introduced into the practices of both PHOs 2 and 3. These latter systems were being positively received by several GPs interviewed, representing both PHOs, and appeared to have the potential to elevate available CDS considerably.

Quantitative data from the postal survey (Table 6.14) showed lower mean figures given by PHO 2 for all items except 'Focused evidence-based health information'. Alerts and reminders were rated highest by PHO 2, which matched the highest result of 7 from the pilot study (PHO 1). The highest score in PHO 3 was for 'Prescribing decision support'. Lowest scores in PHO 2 were for ''Expert' opinions/systems', and in PHO 3 for 'Focused evidence-based health information'. As the figures were mostly lower for PHO 2, it would appear that the use of CDS tools in general is slightly less in that PHO, although there was strong agreement of a low incidence of the use of ''Expert' opinions/systems'. The use of 'therapy critiquing and planning' was reported by respondents to the questionnaire survey in PHOs 2 and 3, and the result appears to contradict the qualitative findings. This could indicate that the example given, of 'Clinical Guidelines' should have emphasised 'electronically delivered' guidelines, and may have elevated the resulting scores.

Table 6.14: Questionnaire results for question 1 – use of CDS tools

Questionnaire data relating to question area 1 (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally, and 7 = extensively)		
Decision Support Tools:	**PHO 2**	**PHO 3**
Alerts and reminders (e.g. allergies; drug interactions)	4.8 (0 - 7)	5.8 (2 - 7)
Prescribing decision support (e.g. MIMS)	4.5 (0 - 7)	6.0 (4 - 7)
Diagnostic assistance/assessment tools (e.g. risk calculators/ algorithms)	4.0 (0 - 6)	4.2 (1 - 7)

Therapy critiquing and planning (e.g. Clinical Guidelines)	3.4 (0 - 6)	3.6 (1 - 7)
Focused evidence-based health information (e.g. Medline, Cochrane)	3.8 (0 - 6)	2.0 (0 - 7)
'Expert' opinions/systems (e.g. image recognition and interpretation)	2.4 (0 - 6)	2.8 (0 - 7)

'CDS Tools' findings

Most CDS tools were found to be used by management and practice staff of the PHOs, although their use was variable, depending, for example, on user skills. New systems were being implemented by the PHOs, at practice and PHO-MS levels, with the potential to provide a higher level of CDS, with improved research and reporting components, and improvements in therapy critiquing and planning. Items of interest including information on areas where the use of eCDS tools could be improved are listed below:

- Some users needed increased abilities to fully utilise eCDS tools embedded in available systems, such as alerts and reminders, prescribing support, and diagnostic assistance/assessment tools.
- Information overload by prescription support tools appeared to be limiting their use, suggesting adjustments, or further adjustments, by developers would be beneficial.
- Access to new risk assessment tools and CDSS was favourably anticipated by many.
- Potential users needed to have better web searching techniques, guidance on the choice of useful sites, and improved skills using their PMS, to encourage the use of focused evidence-based health information.
- The use of expert opinions/systems, especially with reference to those such as image recognition and interpretation, was limited.
- Systems being newly introduced appeared to have the potential to considerably elevate available CDS, and were being well received by practitioners.

6.4.1.4 The use of CDS features:

The following is a list of CDS features, based on Kawamoto et al. (2005) and Metzger and MacDonald (2002), which:

1. Bring information and knowledge to the point of clinical decision making (decision support delivered at the time and location of decision making).

2. Provide decision support automatically as part of the workflow.
3. Provide knowledge relevant to the particular clinical situation (e.g. for a particular patient, issue or medication) when required.
4. Combine clinical knowledge with patient information to help you keep abreast of the patients health status (e.g. for prevention, intervention or follow-ups).
5. Identify patients lost to follow up or overdue for recommended interventions.
6. Alert you to contraindications or potential problems by checking planned actions against patient information and generally accepted clinical knowledge.
7. Provide actionable recommendations.

PHO 1 (pilot) - CDS features:

All the above features were represented to some extent by systems used in the pilot PHO. During interviews most of both the PHO-MS and practice staff reported some benefit from each of the features, with the exception of the PHO-MS staffs' reactions to the use of the Feature 6 'Alert you to contraindications or potential problems by checking planned actions against patient information and generally accepted clinical knowledge', which was described by all PHO-MS staff who commented as not applicable to their situations. On the same feature a doctor commented:

> The main way it does that is through drug interactions in MIMS…which isn't that user friendly, 'cos usually it gives you a list of about 20 interactions for every medicine, because there's so many of them… …they did do something to that and made the more important ones come up, and leave the less important ones at the back, but still…. (GP, Brian)

A practice nurse illustrated how she found her system in terms of Feature 4 'Combine clinical knowledge with patient information to help you keep abreast of the patients health status'

> It's not going to tell you they're late for their INR, like they are on Warfarin and they haven't been in to get their blood test done…the system isn't geared up for that, because you've got to put that in manually, but it tells you, like…in your recall system, if somebody hasn't come in on time for whatever reason…and…you can create tasks for yourself…so it does - yes we do somewhat use that, but it is not the whole solution…. (Practice nurse, Kath)

Responses to Feature 5 'Identify patients lost to follow up or overdue for recommended interventions' were widely positive. The pilot questionnaire survey results (see Appendix 5, Table 10.5) showed that the feature most commonly appreciated by the respondents was Feature 5, with the least common being Feature 7 'Provide actionable recommendations' (Engelbrecht et al., 2006).

PHO 2 - CDS features:

A rural doctor and a PHO clinical manager provided insights on the use of features of available systems. The doctor was positive about his systems ability to provide all the features to some extent, but in some cases thought they were only weakly provided, or provided but not exploited by himself. On Feature 1 ‘Bring information and knowledge to the point of clinical decision’ he explained:

> …they do and there’s a lot of knowledge in there, but I don’t access a lot of it, ‘cos it’s just…[laughs] I haven’t sat down and worked my way through it all, and familiarised myself with it all. One or two things I know about…but I don’t - there’s a lot of other things there I don’t tend to, sort of, take information from. Unless you’ve actually sort of flicked it out and realised that, “Oh, yes. This is good” … …Actually, accessing the records it’s good, but I still think you can’t scan quite as well as with an old piece of paper…. (GP, Blair)

The clinical manager thought Features 1, 3, and 6 were not appropriate for her work and was only weakly positive about the others. However, she commented that she could see the potential for nurses working ‘on the ground’ to use their systems more effectively, as they had not tended to use their systems as in a practice setting through, she felt, a lack of training and “computer savvy”.

PHO 3 - CDS features:

Three practice staff gave their opinions of CDS features, a practice nurse and two GPs, all from different practices. The practice nurse was generally negative about the ability of her systems to provide CDS features, possibly because she was working in a GP practice where the PMS was not used for patients’ notes. However, she felt that the system was useful for support in recalling patients. One GP was sceptical about the ability of his systems to exhibit the CDS features, feeling that Features 2,3,4,6 and 7 were not represented. On Feature 5 ‘Identify patients lost to follow up or overdue for recommended interventions’ he described how his system worked:

> It does do that as a system, but you have to make the system… …you have to run the screen, so it doesn’t automatically…we’re going to get through the PHO, a [patient health status interface], which will do that, and it’ll prompt you…whereas the way it works now is, we have to run the screening tool which then gives us if somebody’s overdue, if not they can be sitting in front of you and you won’t necessarily realise it, unless you think - mind to go back and remember when the last time this was done… …it does as a system, but not as an interface. It’s two separate sort of things, so as a system it can, but as an interface it doesn’t. (GP, Tim)

The other GP was mostly enthusiastic that his systems did provide the features, although he admitted that, regarding Feature 7, ‘Provide actionable recommendations’, he only utilised his system partially:

> Just a little…because often what I do then, is actually go and look at my big books to check how important they are. (GP, Stewart)

Cross case analysis - CDS features:

Both pilot study PHO-MS and practice staff reported some benefits from each of the features listed above except Feature 6, which was described by all pilot PHO-MS staff who commented as not applicable in their work. Interviewees answering these question items from PHOs 2 and 3 were a PHO staff member and GP in PHO 2, and a nurse/manager and two GPs in PHO 3. Each case presented a GP who was generally positive about the ability of his practice system to provide the features discussed. However, sceptical reactions were presented by the PHO staff member from PHO 2, and the practice nurse and remaining PHO 3 doctor. Reactions to the items by the PHO-MS staff member were likely to be due to her particular role, as indicated by her comments that community based nurses working for the PHO had a greater potential to utilise their systems to provide the CDS features in their work than did she herself. The PHO 3 practice nurse worked in a sole GP practice where patients’ notes were not stored electronically, therefore reducing the ability to exploit some of their systems capacity. From the interview data, variations in individuals’ experiences of CDS features appeared to be linked to the appropriateness of that type of support for their work roles, or whether their systems were being utilised fully. For example, where a PMS system was not used for storing doctor’s notes, the CDS features were under utilised.

However, there was also agreement between practice staff at all three PHOs that extensions to, or further development of their systems were needed to fully realise some of the features. Therefore, individuals’ work roles, or choices in how they used their systems appeared to contribute to the extent they experienced the CDS features listed above, rather than any vast differences between the cases or their available systems, but opinions also suggested that improvements to, or further development of their systems were needed. The acquisition of new technologies, such as an improved interface recently acquired by PHO 3 for its practices, appeared to have the potential to elevate the level of features available within PHOs.

The quantitative data from the postal questionnaire associated with the question (Table 6.15) showed that in PHO 2 all but one feature received a lower mean value than those given by PHO 3. This could indicate that the practice staff in PHO 3 had slightly more eCDS features available or were more able to utilise the ones they had. This would be consistent with the finding that PHO 2 reported a lower use of eCDS tools in general. PHO 2 results were in agreement with those from the pilot study, shown in Table 10.5, by placing 'Identify patients lost to follow up…' as the highest rated feature, and 'Provide actionable recommendations' as the lowest. PHO 3 rated 'Alert you to contraindications…' most highly with 'Bring information and knowledge…' as the lowest, although 'Provide actionable recommendations' also rated lowly as second to lowest. The three features 'Bring information to the point of clinical decision making', 'Provide decision support automatically as part of the workflow', and 'Provide actionable recommendations', have been found to be amongst the most important indicators of the ability of CDS systems to improve clinical practice (Kawamoto et al. 2005), but generally ranked lowly in the organisations studied. This finding was also consistent with that from the pilot study reported in Table 10.5. (Engelbrecht et al., 2006). An open question asking what other ways computers can help to support CDM provoked a respondent to write "PHO gives bugger-all support to others not using [the organisation's predominant PMS]." (Respondent).

Table 6.15: Questionnaire results for question 1 – CDS features provided by practice IS

Questionnaire data relating to question area 1 (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally, and 7 = extensively)		
Decision Support Features:	**PHO 2**	**PHO 3**
Identify patients lost to follow up or overdue for recommended interventions	4.7 (0 - 7)	4.6 (1 - 7)
Alert you to contraindications or potential problems by checking planned actions against patient information and generally accepted clinical knowledge	3.3 (0 - 7)	5.3 (1 - 7)
Combine clinical knowledge with patient information to help you keep abreast of the patients health status (e.g. for prevention, intervention or follow-ups)	3.3 (0 - 7)	5.1 (1 - 7)
Provide knowledge relevant to the particular clinical situation (e.g. for a particular patient, issue or medication) when required	3.0 (0 - 7)	4.8 (1 - 7)
Bring information and knowledge to the point of clinical decision making (decision support delivered at the time and location of decision making)	3.4 (0 - 7)	3.9 (1 - 7)
Provide decision support automatically as part of the workflow	2.4 (0 - 7)	4.4 (1 - 7)
Provide actionable recommendations	2.3 (0 - 7)	4.0 (1 - 7)
Other Computerised Decision Support:		
Additional computerised decision support	16.7% response	0% response

‘CDS features’ findings

The abilities of organisations’ systems to provide the full range of CDS features studied varied with individuals’ usage, between different user groups, and in different practices. For example, some features were not appropriate for management service activities, and practices not storing doctors’ notes electronically were less likely to be able to take advantage of some of the features. However, technologies being newly introduced were anticipated to increase CDS features in the participating cases. Findings about the use of CDS features include the following:

- Practice members’ abilities to exploit their systems’ capacities were limited where patients’ notes were not stored electronically.
- The introduction of systems with more automated features was considered to have the potential to facilitate greater CDS.
- Practices using minority PMS systems appeared to need increased PHO support.
- The three features important in improving clinical practice, those being ‘Bring information to the point of clinical decision making’, ‘Provide decision support automatically as part of the workflow’, and ‘Provide actionable recommendations’, were not strongly evident in the organisations studied.

6.4.1.5 Summary of question area 1: Computerised CDS.

The use of popular systems for CDS, and a range of eCDS tools and features, was evident throughout the three PHOs studied. However, the usage varied between user groups, member practices, and individuals. Most participants were utilising eCDS, but the study found that there was the potential for its improved use throughout the organisations. The availability of certain eCDS tools and features within the PHOs studied appeared to be increasing as new systems were being introduced by PHO-MS in their organisations, and their usage encouraged in order to fulfil MoH requirements.

6.4.2 Question area 2: Information processing requirements

Are your information processing needs being met?

6.4.2.1 Background to question area 2

In caring for their patients/patient populations, health professionals/managers can face a variety of challenges in processing information, e.g. from information overload. This question explores if computer systems, or improved existing computer systems, might help them cope with such challenges.

This interview question was designed to determine if health professionals have unmet information processing needs, and if so, what those unmet needs are (e.g. information gathering, reporting or other needs). It also sought to find out if health professionals consider that new, or improved existing, computer systems could help them to satisfy those unmet processing needs, and how they might be useful. This part of the interview provided answers to the question **'Are PHO health professionals/managers' information processing needs adequately provided for?'**

6.4.2.2 Information Gathering

PHO 1 (pilot) - Information gathering:

Various difficulties in gathering information were expressed by staff at the PHO-MS organisation. A PHO-MS senior manager outlined the problems across his area, highlighting the challenges caused by differences in practice systems and data quality:

> …we've recently just moved to an electronic - an on-line system of extracting utilisation data from the practices to us, and then we send it back on to the Ministry of Health, and then the return process is the reverse... …I believe that…the most significant problem area is the variability of individual practice [data]. A second issue is the variable IT infrastructure and the bad quality at general practices across the district. (Senior manager, Evan)

Evan thought that a greater level of aggregated clinical data would allow better evidence based decision making with respect to funding, clinical programme priorities and programme varieties. Although the IT manager said she could get all the information she needed, she agreed that things would be much better if all the GP practices had similar systems, enabling data collection to be automated. Another senior manager expressed a need for cross-referencing between agencies outside the PHO to assist in accessing target population groups e.g. for the improvement of access to services, as she felt that the social deprivation index contained vagaries, and should not be relied on solely:

> …there's a danger with information technology…that the information is only as good as what you put into it, and…only as good as it's updated and kept up to date… …in my decision making I use a number of methods, and…face-to-face, human contact, provider focus groups, is essential alongside the research analysis…but having this background kind of information through computer systems…would be good. (Senior manager, Linda)

She expressed the need for someone in the PHO to be aware of available knowledge, resources, and how to access data. A third manager echoed this view, describing her difficulties in information acquisition as, rather than systems' problems, being due to the following issues which contributed to an inability to do research with evidence based data which could otherwise be utilised:

> …I think that it's not necessarily a computer thing, it's an IT capacity capability. We don't have the IT support people, and we just cannot get the data, and we don't have the data of the cases that I require…or can't access it, or nobody has the knowledge to access it. (Population health manager, Gwen)

A PHO-MS based screening co-ordinator, Karen, felt that although gathering data was possible, she found it difficult to get information regarding the roles of others she might find helpful, and a PHO-MS clinical manager, Laura, felt that extra training in the use of a software product, in her case MS Access, would be welcome. A community nurse also thought extra training would be helpful, in her case for the use of spreadsheets and how to access useful information. She experienced particular problems accessing information due to her mobile status, and voiced her wishes for a better integrated system:

> …and to be linked up to [a secure messaging service], too, for results…the other thing is, the only way I can access my e-mails is if I'm in this office, and being mobile, if I'm not in this office daily, I can't get my e-mails and that's very frustrating…. (Community nurse, Kelly)

The lag time in processing prescription data was seen as a data, rather than a systems' issue, by a pharmacist:

> …I don't think we are going to get around this, but there is always a bit of a lag time in terms of what's prescribed versus what's paid out on the claim, versus when the data gets back to the 'Pharm. house'[2], before it comes back to people like us…. (Pharmacist facilitator, Barry)

From the practice perspective, a practice nurse, Kath, expressed a need for accurate data to enable her to contact patients, which she felt was a crucial function. An

administrator at the practice said that she could not get all the information she needed citing 'people' as the problem issue:

> …the information is there, it's just getting access to it and it's a difficult thing, so…'Can you gather it all?' – Yes, if we could get a hold of the people we need we would get all the information that we'd require. (Administrator, Bridget)

[2] The 'Pharm. house' is the pharmaceutical information database jointly owned by the Ministry of Health and Pharmac the Pharmaceutical Management Agency of New Zealand

Natalie, a doctor at the practice, felt that she had some issues with information gathering but that it was an educational issue which could be improved if she utilised the help of practice IT staff which was available. This latter interviewee exemplified how individual doctors within a practice could use their systems quite differently, and even a practice with dedicated IT support could still include clinicians who were not using their available systems fully.

Another GP, Brian, also thought his information gathering problems were not the fault of his computer technology, but rather that needed information had not yet been entered, and his comments suggested the need for increased staff resources to help with PHO requirements. He spoke of how the electronic recording of historical data was very time consuming. The practice had already invested a lot of time in improving their database due to the establishment of the PHO, but did not have the resources to enter historical data, other than over a very gradual time frame. He explained that his database was good for checking what had happened to people in the last three or four years, but bad prior to that. He stated that the PHO wanted really accurate data but felt that, with current limitations “they’re going to get a shock when they need it ‘cos I don’t think it’s going to be here”. He explained that he also found it difficult to deal with large amounts of paper based information, and was not comfortable with scanning the data in as it was too time consuming to identify each document appropriately. Read coding was given as an allied issue and he thought it might help if everyone was taught how to code properly “because it really is an art”. Of the reasons doctors do not put Read codes on at all, he commented:

> …some people have just made the move to being computerised just before the PHO came into existence…and they’re still finding their way around it. They take a long time to do things, they’re slow and, you know, when you’re busy the last thing, if you’re not done, is looking at whole lots of classifications and lists and sticking them onto somebody’s…datasheets. (GP, Brian)

A practice administrator at the same practice, Sonia, said that, although she had experienced an increase in her information gathering activities, she could get needed information and said they had good systems. She commented that it had been hard work ‘cleaning-up’ the database initially. However, Tracey, the practice nurse, expressed a desire for Internet access to information to help with patient enquiries and her own on-going education. At the time of the interview she had to either ask the doctor for access or use her own computer after hours at home. She also commented about the increased need to gather information and collate data, but felt that, that was “…something that we don’t do very well here yet.”

A solo GP, Stephen, said he was happy with his ability to gather information, saying he did not rely on his system, but preferred to use books and second opinions. He had not yet experienced increased information needs but was complying with PHO suggestions to upgrade his systems in anticipation of that event.

PHO 2 - Information gathering:

PHO-MS staff felt they were able to access needed information although the IT manager, Ethan, felt that agency communications needed improvement, and a manager, Leanne, found the process of information gathering to be cumbersome, stating that she felt it would be better with an integrated system. Wendy, a clinical manager, could gather information she needed at the time of the interview, but had concerns that the future was going to present challenges.

A Practice Nurse in an urban practice felt that although needed information was available, it was not always timely, and thought that improved systems might help although she did not know how:

> …you can't always get it [information] when you want it… …we spend, as nurses, quite a lot of time chasing up information so that all the data is logged in, in front of the doctor, for when the patient is presenting. You'll look at your list and say "oh yes, they're coming in this morning", but I know they've been somewhere - we haven't got anything back about them yet. (Practice nurse, Maria)

At a rural practice, a doctor, Blair, said he could gather all the information he needed, and felt that his system, broadband and home access were "great". However, he did feel that he would like better linkage with the PHO-MS and more communication with "the others" [other GPs]. The practice nurse was not as positive, stating that GPs needed more information, and that she felt like they were "jumping through hoops all day long".

A nurse at another rural practice, Carla, considered that belonging to an older age group was a negative factor in relation IT and training issues around information processing, and felt that her practice was disadvantaged having a PMS which was atypical within the PHO. The practice administrator said she could access all the information they needed but would like it electronically, illustrating the lower end of the integration spectrum experienced by GP practices. She wanted Labs. etc. sent electronically to cut down on filing, email without security issues, and Internet access:

> We've had to talk about getting a stand alone system, but it's just something the [associated organisation] won't look at…Labs. sent electronically and all the - cut down on filing - it would be great. (Practice administrator, Nichola)

PHO 3 - Information gathering:

A senior manager for the PHO-MS, Carol, said she was able to collect information but was working towards 'pulling' data from practices, by agreement, and would like to have more timely access to prescribing data. A pharmacist facilitator, Chris, agreed that he could gather needed information and would like it quicker in order for it to be acted upon in a more timely and up-to-date manner, helping to facilitate remedial actions. Historical data was slow to process via HealthPAC[3] and Pharmac[4], although developments to national level systems were underway and improvements were expected over the next 12 months. The IT manager, Garry, said that although information gathering could be improved for the PHO-MS, it was mostly acceptable. However, he said that if the PHO management and GPs were considered together, it was not possible for everyone to get all the information they needed. He spoke about information overload in the practices, and how email could be a problem with people often feeling swamped by it.

A GP from an inner city practice said he could get needed information, but thought that better systems could improve matters for him. He liked using the Internet, but felt it took too much time and would like to see CDS more integrated:

> …you can get everything you need because the Internet is just so huge…but it can be a bit laborious searching databases and stuff… …[I'd] do it more if it was quicker and…if you had a good site that was sensible, and distilled information really well. That sort of thing. I'd use it a lot, and then finally I think that on the computer, decision making could be integrated a lot more, but obviously that would be quite programming intensive, but it could be much more functional, because it's got all the information there. (GP, Tim)

At the same practice, an administrator, Diane, was happy that she was able to get all the information she needed and said things were always improving, giving the example of how they would soon be able to get Special Authorities[5] electronically. The PHO was supporting the practices to get a secure commercial VPN connection which would facilitate this, and she saw this as an example of how improved systems could help them. Another GP said he could normally acquire all the information he needed, but thought it could be structured much better and be more timely:

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[3] HealthPAC is a business unit of the New Zealand Ministry of Health
[4] Pharmac is the Pharmaceutical Management Agency of New Zealand
[5] Authorities needed for the prescription of certain subsidised medications

> One of the things you don't get in a timely manner are benchmarking reports, which isn't really so much a function of an individual system, but the fact it takes several months for HealthPAC or BPAC[6] to provide the data back, by which time your data is already a little out of date and lost its impact, and that's difficult, because…you sit in your little office isolated from everybody else and having benching reports is actually quite useful to see where one's at. (GP, Stewart)

A nurse, Sylvia, at the same practice said she was happy with the current status quo regarding their computer systems and ability to gather information, although she would like a little more information about issues in their geographic location, perhaps via the DHB or Health Protection, for example, in the form of a newsletter. Their practice administrator, Zoe, was also positive about their abilities to gather needed information and was enthusiastic about how access to National Health Index (NHI) information could facilitate dealing with casual patients. However, Carrie, a practice nurse at another practice, felt that although information gathering was not a problem, if she were younger, she would be better able to determine if it could be improved with better computer systems.

Cross case analysis - Information gathering:

The pilot case study (PHO 1) provided many insights into information gathering needs, particularly at the PHO-MS level where most staff interviewed expressed issues. Several individuals commented on the need for training in the use of database and spreadsheet software, and how to access useful information, and mobile staff needed the use of systems integrated with PHO-MS systems when off-site. The need for more IT support was evident. The management shared the opinion, with their counterparts at PHOs 2 and 3 that, ideally, all the GPs in the PHO should use the same practice management systems, and all three had mostly achieved that goal. Many of the difficulties outlined in PHO 1, particularly at the management level, could have been linked to the fact that the organisation had only recently been established, and contrasted with the older PHOs 2 and 3, where management staff seemed more positive about being able to gather the information they needed. Staff of the PHO-MSs for PHOs 2 and 3 felt they were currently able to gather needed information, but concerns were voiced by staff at both locations. Although information acquisition was adequate for the time being, one person at PHO 2 had commented that it was likely to be challenging in the future, and more timely access to prescription data was desired at PHO 3. The latter requirement was also voiced by pilot study management staff who

[6] Best Practice Advocacy Centre

also stated the need for more timely acquisition of prescription data, plus an increased level of aggregated clinical data which would facilitate better evidence based decision making. PHOs 1 and 2 management staff stated that data gathering could be improved in their organisations through more integration of systems, and better communication with external agencies, with an integrated system seen as a way to eliminate current cumbersome procedures by a manager at PHO 2. At PHO 3, steps were underway to begin ‘pulling’ practice data, with the agreement of the GPs, and it was acknowledged that national level improvements in data processing were likely to be forthcoming over the next year.

Practice members at the pilot PHO had mixed opinions on their ability to gather needed information. One staff member at the largest practice expressed a need for accurate data, with another feeling that needed data was available if only the appropriate people could be contacted. Satisfaction in being able to gather needed information was expressed by staff at two PHO 2 GP practices and three PHO 3 practices, although people in the former PHO expressed several requirements including, again, more timely information, for example in terms of patients they were treating who had been seen by health care professionals elsewhere. A PHO 3 practice manager pointed out that improvements were being made all the time, and acknowledged PHO-MS support. However, her PHOs’ IT manager stated that, viewing the PHO-MS and GP practices as a whole, it was not possible for everyone to get all the information they needed, and said practice staff often suffered from information overload, for example, by being swamped by e-mail. A PHO 1 doctor explained the problems associated with historical data and Read code entry, which were largely related to a lack of time and resources. Another limitation was the restriction of Internet access which was an issue for a nurse in a practice where others were connected, and was a deliberate policy in a sole GP practice, although system upgrading was soon to change their approach. At a rural practice, remote from her PHO 2 management service, one nurse felt she needed more training in information processing and experienced difficulties with her system being atypical from others in the PHO. She mentioned her age in regarding to IT knowledge, as did a Practice Nurse at PHO 3, suggesting that some staff would benefit from measures to increased confidence in using their systems. The same practice also had issues around Internet access, use of e-mail, and receiving needed information electronically, including for example, laboratory reports. Although this practice experienced restrictions connected with its associated organisation, not experienced by other practices in its PHO, its location at a great distance from the PHO-MS could have contributed to some of the challenges it was experiencing. Possible eCDS improvement areas were suggested by doctors at PHOs 2 and 3. At PHO 3, one doctor would appreciate CDS to be more integrated in his system and would like to increase his use of the Internet given more time, while another would like better structured and more timely information. One PHO 2 GP, who was particularly pleased with his system, broadband, and home access, also suggested improvements could be made through more contact with other GPs and better linkages with the PHO.

The quantitative data provided by the postal questionnaire (see Table 6.16) suggested that GP practices in PHO 3 expressed a greater ability to access the information required for CDM than those in PHO 2. The practices in PHO 2 gave a slightly higher score for their estimate of the extent that information required for CDM could potentially be better accessed with new computer systems, or improved use of existing computer systems.

Table 6.16: Questionnaire results for question 2 – Information gathering

Questionnaire data relating to question area 2 (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally, and 7 = fully/very much)		
Information gathering issues:	**PHO 2**	**PHO 3**
Extent of ability to access the information required for clinical decision making	4.0 (0 - 7)	6.5 (5 - 7)
Estimation of extent that information required for clinical decision making could potentially be better accessed with new computer systems, or improved use of existing computer systems	4.8 (0 - 7)	4.1 (1 - 7)

‘Information gathering’ findings

Information gathering involved important issues to both PHO-MS and practice groups. The integration of IS, both within the PHO and with external systems was seen as pivotal in providing both high quality, and timely data, and steps were being taken at PHO and national levels to address the issue. The research highlighted some areas for improving information gathering which are listed below, together with other points of interest:

- The organisations studied required improved systems integration to be better able to gather needed data,
- Practices using PMSs which were not in the majority in their PHO sometimes experienced disadvantages.

- More training and support was needed for information processing with a PMS system atypical in the PHO.
- Some PHO-MS staff expressed a desire to be able to extract practice data automatically.
- Several mobile staff lacked good systems integration when off-site.
- Not all appropriate practice staff, e.g. nurses, were able to take advantage of email and the Internet, despite them being present in their organisation.
- Some practice staff needed encouragement to utilise their existing practice systems for information gathering, with some citing their age as a limiting factor.
- Well structured, timely and accurate information was needed by GPs and PHO management. Timely sharing of patient information between providers was lacking, particularly for GPs who wanted updates about patients treated elsewhere.
- Better linkages from GP to the PHO, and more contact with other GPs, was required.
- Systems were thought to need on-going updating with improved CDS.
- Practice staff needed more time to increase their use of the Internet for information gathering, and there was a need for more time and other resources to facilitate historical data and Read code entry.
- PHO-MS staff required more timely access to prescription data, greater levels of aggregated clinical data, and better communications with external agencies.
- PHO-MS staff expressed the need for additional training and support with software use, and the access of useful information.
- Practice staff needed to be able to contact appropriate people possessing required information (seen as a ‘people issue’).
- PHO-MS support being provided for continuing improvements to data collection, were considered important and were acknowledged.
- Practices needed support in dealing with information overload.
- Broadband and home access were greatly appreciated, as was PHO support for such system improvements.
- National level improvements in data processing were eagerly anticipated in the near future, by PHO-MS staff.
- The quantitative data indicated that new computer systems, or the improved use of existing computer systems were considered by many to potentially facilitate a greater ability to access information required for CDM within PHO organisations.

6.4.2.3 Reporting

PHO 1 (pilot) - Reporting:

A senior manager, Evan, felt his organisation could not produce all the reports it needed to, and that improved computer systems might help. He felt that he would like to be able to communicate information better to their practices and was concerned that there was too much paper based information and that the “paper and fax. trail” should be removed. This view was endorsed by Linda, another senior manager who felt the PHO-MS systems were not yet ready to deliver the level of reporting needed of a PHO. Problems associated with reporting were illustrated by the IT manager as follows:

> Some of the reports for some of the data that we are asked about, I would love to be able to run easily across everybody’s computers. That’s just sorting out historically how we access the data, and in most cases we actually physically have to phone someone or fax them and say please press these buttons. (IT manager, Nadia).

The need for access to good data in addition to improved software was described by another staff member who said that although the PHO was able to produce needed reports he thought they could be better than they were:

> ...it would be nice if we could drill down to a specific sub-population, of either patients or providers...by and large in this region, we can’t identify those people who have raised blood pressure, because general practices don’t specifically record those. In the future I’m hoping they will…. (Pharmacist Facilitator, Barry)

Problems of accessing data, particularly statistical reports, were voiced by Gwen, a population health manager, because historically that work had been done by one person who still guarded the information. With other staff perhaps lacking knowledge or expertise, and without the necessary IT capacity, certain work had not been done. The advent of an additional IT support person in the organisation, to take responsibility for the PHO-MS systems, was gleefully anticipated in the hope of finally being provided with access to needed information, and the ability to be able to back up their knowledge with evidence.

On a personal level, a screening co-ordinator, Karen, felt unable to provide all needed reports and thought that her own computer expertise, knowledge, and ability to contact others with the necessary skills, were lacking, rather than the technology being inadequate. However, she felt that improved systems could help and cited formatting of reports as being a challenge. She was in agreement with other PHO-MS staff in saying that there was room for improvement in respect of reporting, processes, communication systems, and “clarity about what’s required by whom”. Similarly, Kelly, a community nurse, expressed limitations in her ability to report weekly and monthly statistics, due to lack of ability with spreadsheets, and felt that there must be a better and more time efficient way of providing reports with information being automatically transferred. In addition, clinical manager Laura said she would be able to produce reports faster with improved skills, and was trying to streamline reporting from the mobile health nurses by implementing a move from weekly to monthly and quarterly reporting, with all nurses working to the same schedule.

At the practice level, an administrator complained that there were a lot of reporting needs under the PHO but the PMS query base was not being updated quickly enough. She stated that, unless the government decreed a certain change e.g. to a report field, practice requests to the vendors were slow to be implemented. She felt that government requirements were really broad and vendors were not consulting the users enough:

> …they [the PMS designers] didn’t go to the clinics and say “How do you think you would…” and, “What fields do you think you would need to report on for your stats.?” They just design some and then you’ve got to try and pick out what they’ve set up as query fields to try and design some - which is really annoying, and if they’ve left the fields out that you need, then you make a request, and you wait for the next drop down, and hopefully it’s in there - maybe it won’t be, so you work your way around it…. (Administrator, Bridget)

Brian, a doctor at a smaller practice, felt they had somewhat increased reporting needs, and spoke of the performance management programme which was just starting, expressing a concern that certain information would not be available when needed. He gave the example of how mammography data would take his practice two years to database and make current. His practice nurse and administrator both said they were able to fulfil their reporting needs at that time. Lastly, a sole practitioner, Stephen, also found his practice had been able to do all the reporting needed so far, but knew that reporting requirements were increasing.

PHO 2 - Reporting:

A pharmacist facilitator described a number of reporting activities she carried out and commented on some of the new reports and how, on a visit to another PHO, she had been interested to see a system which facilitated reporting:

> …my role’s changed a little bit with the advent of the PHO performance management project, and we’re getting all of the data files in Excel, but I

> imagine that as time goes on the files will be too big for Excel so we might be looking at other options to manage the information. So I anticipate that we'll have to start using the Access more, or a bigger or more grunty kind of database…
>
> …they [another PHO] had written programmes…and their system could take that data [big data files from 'Pharm. and Lab. warehouses'] and process it…they could feed the data into their system and it would…they had queries all written, and they'd get given information about who was using what tests and what drugs… . (Pharmacist facilitator, Helen)

A clinical manager, Wendy, said that, although the PHOs reporting efforts were mostly fine, she thought that on occasions they could do much better, and thought that there must be some easier ways to tackle the work which were possibly related to staff training.

Blair, a rural doctor, said that the implementation of the PHO had increased their reporting needs, and said that there was a need for practices to have someone interested in manipulating data and creating queries. A nurse at the practice, Claire, was enthusiastic but said she could not run all the reports she would like, and described network problems which resulted in their system slowing down when she ran queries, causing other staff members to complain.

Another rural practice nurse, Carla, found that her reporting was hampered by her lack of training with her PMS. Her practice used a system which was different to most others in the PHO and she felt she would like more training from the PHO-MS, and better support from the vendor who sometimes did not follow up with query assistance. Nichola, the practice administrator, explained how their reports were sent by post, including the quarterly capitation report for the PHO which was loaded onto a CD before posting, a procedure which was imposed by their lack of connection to a secure messaging service. She also said that her problems with query building could benefit from training by the PHO-MS who had only visited infrequently. This was possibly related to the remote location of the practice. These comments contrasted with those of a practice nurse from a large urban practice, Maria, who said she was satisfied with her reporting activities.

PHO 3 - Reporting:

A senior PHO-MS manager, Carol, felt that reporting could definitely be done better in the organisation and her comments were reflected in the interview with a pharmacist facilitator:

> Well, we can do it, but we would like to be able to do it a lot quicker…we'd like to be a lot more responsive…a lot of it's outside of our control…When we get into a new system, which is dependent on, like, the District Health Boards of New Zealand, or some other organisation providing that information a lot quicker, then we'll be better off. (Pharmacist facilitator, Chris)

A service manager described how the data for different reports had to be 'pulled' in different ways due to their differing parameters. She gave the example of how practices with one type of PMS could provide the information through a smart form technology, whereas those with another would employ a report builder and practice invoices. Another report would be based on a query for both PMS types being used, and some new reports would have to be compiled manually due to the PMS systems only having limited functionality in that area at the time. This illustrated the need for a variety of strategies in dealing with the range of member practices' reporting capabilities. The PHO was also providing support in the form of incentives and advice where necessary:

> …the PMS's aren't quite ready for it yet, so it takes time to write it down, so…for instance with a financial incentive…as it becomes part of their core business then that may…just become what they do, but…that's trying to bring forwards change…there may be times when we as a team are trying to plan for a future project or funding stream, and rather than inconveniencing the practice team, I might go out and just pull the data rather than ask them to do it…you can imagine, practice teams are so busy that you're obviously bringing one more thing to do, and often just turn them off, so the less that we do that the better. (Service manager, Sally)

Two practices where the doctors had very different approaches to their use of practice systems, with a non-user contrasting with a high user, were both positive about the use of electronic systems for reporting activities. A doctor at a small practice, Robert, described manual reporting, for example of routine cholesterol tests, as one of his "biggest curses", and appreciated the advantage of his practice system receiving laboratory data electronically, even though he does not use the computer himself. The other GP, Stewart, was looking further ahead to having seamless auditing. At the time of the interview auditing was active and time consuming but the PHO-MS was switching to having its own data-warehousing in-house with the intention of 'pulling' the information from the practices instead of having them 'push' it to the PHO-MS. This would speed the process, with the PHO-MS being able to complete the audit and return it quickly to the practices and lessening their workloads. When asked if all the other practices were happy about that development he answered:

> All bar one who's philosophically opposed to the world really…One is a bit unhappy, but it's around…being very specific about what you drag out, that you don't drag out individuals, you drag out amalgamated data rather than…in

> terms of audit and so forth… …we're looking at the population much better. (GP, Stewart)

Although this doctor was an enthusiastic end user, when asked about his ability to produce needed reports he said that he could, but it was not always easy and that certain skills were needed to get the information out of the system correctly. With the establishment of in-house PHO data management he thought things would get easier for the practices:

> …we already have someone in the office who's more [predominant PMS] trained, and she knows how to do the query builders for [the predominant PMS], much, much better, and not get flaws in the data that you can get, and then, with [the IT manager's] team taking over, and actually having a proper data analyst there you get that expertise. (GP, Stewart)

The practice nurse, Sylvia, and practice administrator, Zoe, from the same practice agreed that they could produce all the reports needed from them, although the administrator admitted that they had taken on extra staff to cope with the increased workloads. Finally, a practice administrator at a third practice, Diane, also said she was able to produce needed reports, but thought there was always room for the improvement of their systems.

Cross case analysis – Reporting:

A number of PHO-MS staff at all three locations felt their reporting could be better, citing challenges in the areas of access to good data, computer systems, and staff training. Senior managers at PHO 1 thought they were not yet able to deliver all reports needed, and that improved systems were required. The ability to access good data, was also a requirement mentioned by several staff, with improved software, data recording at the practice level, and easier access to practice systems being mentioned as areas for improvement. A senior manager at PHO 3 thought their reporting could be improved upon, especially in terms of their response times, although much of the limitations were thought to be outside their control, and dependent on the speed of data provision by other organisations, with another staff member stating that PMSs were not yet ready, and practice level changes needed to be encouraged.

Several PHO 1 management staff expressed the feeling that they would be better at reporting if they had more computer skills, or help to access needed data, and in one case access was limited due to another individual. This was echoed in PHO 2 where, although their reporting efforts were described as mostly fine by a PHO-MS staff member, there was a recognition that improvements could be made, possibly with more staff training in ways to tackle the work, and more use of MS Access or other databases.

All three PHO-MSs had, or were installing, data-mining software at the time of the interviews. The PHO 1 management service was just starting to collect quarterly patient enrolment data automatically, and at PHO 3, they were about to implement in-house data warehousing where it had previously been contracted out, intending to extract data from the practices without their having to spend time preparing it for management.

Automatic data collection by the PHO-MS was seen as a very positive move by a PHO 3 doctor who felt it would ease workloads and speed the return of information to the practices. In addition he felt the patient population would be better observed. Where most doctors were said to be positive about this move, there had been some concern, voiced by one GP, that only amalgamated rather than individual data should be extracted. Current difficulties in reporting were reported by the GP as being reduced by a PHO-MS staff member, skilled in the predominantly used PMS, being available to help with query building, and would be improved further with the new access to a data analyst in the IT team. However, his practice had taken on extra staff to cope with increased workloads, pressures of which were also apparent in other organisations. Practice staff belonging to PHOs 1 and 3 also, cited issues around increased reporting workloads and data handling, and both criticised PMS vendor responses to practice needs. Within PHO 1, staff at two practices said they were able to fulfil their reporting needs, but there was agreement that there were increased reporting needs under the PHO with more to come, and that it was difficult for practices to initiate and maintain up-to-date databases of necessary information. There was concern that PMS vendors were slow to respond to practices' needs regarding updating query bases. A doctor at one of the PHO 2 rural practices, described the necessity for practices to have a staff member who had an interest in data manipulation and querying, and also had network issues within the practice which resulted in difficulties running queries that overloaded and slowed the system. Lack of training was also mentioned by staff at a remote PHO 2 rural practice, who felt they needed more support from the PHO-MS particularly with database queries, and better responses from their PMS vendor. This was in contrast with comments by a practice nurse at a large urban practice who stated that she was satisfied with her reporting activities. Staff at the former practice were also unable to access a secure messaging service, due to special organisational restrictions, meaning that reports had to be sent by post. As mentioned before, their remote location was possibly partly responsible for limited contact with PHO-MS staff.

The quantitative data (see Table 6.17) indicated that PHO 3 practice staff possibly felt better able to produce needed reports than PHO 2 returning a score of 6.2 from the former compared with 4.3 for the latter. PHO 3 practices gave only a slightly lower score for their estimation of the extent that new computer systems, or the improved use of existing computer systems could potentially improve their reporting, where their figure was 4.3 compared to 4.5 from PHO 2. Therefore, although PHO 2 might have been experiencing more reporting difficulties, both PHOs gave a moderate score for their opinions of the extent that new, or improved use of existing computer systems could assist them in their reporting activities.

Table 6.17: Questionnaire results for question 2 - Reporting

Questionnaire data relating to question area 2 (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally, and 7 = fully/very much)		
Reporting issues:	**PHO 2**	**PHO 3**
Extent of ability to produce reports needed	4.3 (0 - 7)	6.2 (5 - 7)
Estimation of extent that needed reports could potentially be better provided using new computer systems, or improved use of existing computer systems	4.5 (0 - 7)	4.3 (1 - 7)

‘Reporting’ findings

A number of reporting requirements were identified during the current research, including the need for improved systems and software, access to good data at practice and management levels, the need for increased PHO-MS support for practice staff, and faster vendor responses to practice requirements. Areas for improvement are presented as follows:

- PHO-MS staff required improved systems, including improved software.
- PHO-MS staff stated the need for access to good data, including timely data from other organisations, and better data recording and easier access to data at the practice level.
- The need for improvements to reporting at the practice level, and improved PMS system capability, were evident.
- Some PHO-MS staff required increased support and training in the use of software and the access of data.

- Some practice staff wanted reassurance that automatic data collection from practices by PHO-MS were only targeting amalgamated data, rather than identifiable individual data.
- Added resources for practices were desired, for example, for extra staff to ease increased practice workloads.
- PMS vendors were thought to respond slowly to user requirements, for example, in updating query bases.
- Increased PHO-MS assistance with querying, and initiating and maintaining up-to-date databases, was required by some practices.
- Practices using minority PMS systems or remotely located expressed a need for more PHO-MS support for reporting.
- Where systems support was lacking, IT issues could inhibit a practices ability to run queries easily.
- Of the two main PHOs, one practice group appeared to have experienced more reporting difficulties than the other.

6.4.2.4 Information processing needs/data issues

PHO 1 (pilot) - Information processing needs/data issues:

An IT manager said that growth areas around the PHO were around databases and data management, strategically systematising activities and reducing the high level of data duplication existing on staff computers. However, she explained that even just providing all the staff with an electronic contact manager had proven difficult, and elaborated on impending data issues:

> …I know that they [increased data requirements] are coming, and I do know that the practice management software does have the capability to do what we need it to do, I just would like it to be able to do it easier…so it is not the practice management systems, it is actually the Ministry guidelines that have made the information that we have to collate that much more difficult to get hold of, because they have been a bit woolly about what they want… …I think we can speak for most people that do IT in health. We would actually like IT people involved when they are making decisions about what information they are going to get out of the system, and an understanding of what the work involved is to get this, because its not always just a couple of presses of buttons. That might run the report but if nobody has put the data in, in the first place, you are still going to get a blank report. (IT manager, Nadia)

Data duplication was also mentioned by Kelly, a community nurse, who thought it was important to link and share information within the organisation in a way which would limit the problem.

A PHO-MS senior manager, Linda, was concerned at the lack of trust in information generated by health care systems. Both doctors and patients were querying incorrect information regarding funding, and she thought it was difficult for the public to understand their entitlements, or correct any problems they encountered. She stated that the PHO needed to ensure that information it used from different agencies was reliable, as otherwise the strategy would be perceived as not working. She thought that an audit system of information systems was necessary in order to engender trust that information within primary health care was supported by standard formats. She also voiced concern that it was difficult for new staff to get an overview of the PHO and said she would like a website which would help with that situation and enable the sharing of information between the PHO, its practices and the public.

Human factors in data issues were discussed by a pharmacist facilitator who outlined data problems stemming from nationally managed data repositories such as the 'Pharm. and Labs. warehouses' and those at HealthPAC. He confirmed that there is a need to determine if the information derived is complete as areas of data can be missing. He saw an important area of his work to be the interpretation of data which could not be done by a computer system, and said it was important to know what was behind the data. He felt that suggestions for improvements were not being acknowledged, that problems were considered of low importance, and that a national approach was needed, but acknowledged that one was underway:

> It is a matter of working with the national organisations….or government organisations such as the Ministry and DHBNZ…working with the end user, which doesn't happen as often as it should do. The immunisation register is a case in point. It was somebody's wonderful idea, and they got it up and running, and when they tried to roll it out there [were] all manner of problems, and there was a fair amount of not wanting to lose face at the top end, and the problems that were reported at the bottom end weren't really a problem to the top end…...but that's not a computer thing, it is a human thing. (Pharmacist facilitator, Barry)

On the subject of changes to data management with the establishment of the PHO, he said that he was able to fulfil his information processing needs but thought that it could have been done quicker and easier with better data presentation and better systems. Performance target data coming through at the time was "fantastic" but was presented on spread sheets and required manipulation to present it meaningfully to the GPs. This was both challenging and rewarding as it took some time but enabled him to have a much better understanding of the information he was presenting. Where HealthPAC data had been very difficult to handle, he was finding that District Health Boards New

Zealand (DHBNZ) data was very targeted and well presented and the situation was improving all the time. He felt, however, that regular generation of reports within the PHO would be helpful but the resources were limited. This, was seen as a human resource, rather than a systems issue as "…people who could be doing other things are working on the data manipulation instead of doing what their other roles are…"

A screening co-ordinator also described a data issue surrounding the Performance Management Programme. She used the cervical screening measurement as an example of how inconsistencies, which need to be addressed, can arise:

> …the interesting thing about that is that the data they gather, for example to measure cervical screening, is taken from the national screen unit, it is not taken from the general practice base… …for a general practice they'll say, "this is the number of enrolled women who should be participating in cervical screening", and rather than looking at the number of pap smears using the GP data, they are going to gather that data from the screening register... (Screening co-ordinator, Karen)

However, she also described how systems and processes for cervical screening needed improvement in the practices, where a recent pilot project had revealed a lack of clean, up-to-date, screening data, and poor systems in place for communications with the cervical screening programme. Systems were paper-based, with no ability to share electronic information between the two. The project had resulted in a user friendly guideline document being produced for the practices, and the preparation of a proposal to continue and broaden the initial project, for example, by implementing suitcase outreach clinics.

Practice perspectives on funding data issues were provided by two providers. Firstly, an administrator, Bridget, described the challenges faced at her practice in checking their quarterly register data with that from the PHO and HealthPAC. She had always had discrepancies to resolve and found that the PHO-MS had been slow to provide her with the necessary feedback on who was funded in her practice, rendering her unable to deal with the problems quickly. Secondly, a GP described the problems he experienced:

> [The PHO-MS] have come in with disks to take information out and we just can't get an answer as to how some of the people that we've had on our books for a long time are - the patients are suddenly casualised, or, sometimes the other way - the people who have left the practice, we're being funded for under this new system, and suddenly although they've gone and they're being seen by other GPs - they're registered elsewhere - we find the funding is being thrown back at us… …and people who shouldn't be casualised, and were here a

> month ago - normally - you suddenly you look them up and they've been casualised… …I don't know, what it is that's happening there…[The PHO-MS] says "It must be your old programme that's getting confused". It's hard to know, but that sort of thing will improve I think. (GP, Stephen)

PHO 2 - Information processing needs/data issues:

A senior manager, Stephanie, highlighted problems of obtaining reliable data, citing HealthPAC data as a problem:

> I'd like to see HealthPAC data system[s] be more reliable, and honest really. I think we have great respect for the information we're pulling but the issues that we have - and we had this critical one around care plus, one of our contracts - [were] where we were disadvantaged financially because HealthPAC's data wasn't matching ours. We're only fortunate that we've got a DHB that believes in our system - that we've got an accurate approach to data collection - otherwise we would have been in a major strife. So I think that the national systems have not kept up with the development at a PHO level…while we're addressing and resourcing our issues, each quarter, or whenever the audits are undertaken, the same issues are appearing from a HealthPAC perspective and they're not doing anything about them. It's frustrating… …We've had the Minister here…and he agreed that the HealthPAC system was kind of past its date really, and they are about to do some process changes from July, but how long that's going to take, I've no idea - 'cos a lot of our decision making is based on the data, so it's absolutely critical that we have valid and accurate data.

On the subject of data capture from the practices she felt the PMS vendors had not kept up with changing requirements:

> …probably the frustrating thing…is the fact that data capture and where we want to go, the [organisation's predominant PMS] system hasn't had that capability - like disease state registers and all that kind of stuff - and so we've been champing at the bit to have integrated data from a population point of view, but there isn't the mechanism for being able to achieve it, because they haven't [written] the system… …it's about integrating the population data. So, you know, you've got the individual practice stuff, but we're wanting to pull off from the population, you know, 'cos it's all about population health now, and I think that the vendors have been somewhat slow in grasping the needs of the PHOs. (Senior manager, Stephanie)

An IT manager, Ethan, also felt he had some unmet information requirements and that improved computer systems would help to satisfy them, for example, with improved integration with the PHO's rural practices, and data issues connected with community projects were discussed by Wendy, a clinical manager. She had done extensive 'data clean-up' for some of the PHO contract lines, as the PHO had some community services which used a PMS, in a similar way to a GP. Wendy explained some of the issues surrounding data with a colposcopy project and a diabetes regional contract:

> The Colposcopy DNA [‘Did Not Attend’ project] - What happened was, that was identified as a real need, but once we did the project it was evident that the stats. from the DHB weren’t necessarily what was getting referred over and what we tracked, so then that project actually finished, and what we then did was applied some of the principles into some of the other areas that - the contracts that we had, and that’s how I got involved with the diabetes, ‘cos when I started tracking DNA for diabetes, I actually discovered that the integrity of the data was pretty lousy… …[so] I’ve worked at developing some different screening templates within [the organisation’s predominant PMS], and working with the actual service providers to ensure that they’re filling in the right things.

and when asked if she thought improved computer systems could help her, she replied:

> Oh, definitely. Definitely. You know, like, I’m just starting to work on the breast screening and cervical screening and I’d love to be able to pull off all the stats. for our practices from one system, you know, and know that’s it’s clean and accurate. (Clinical manager, Wendy)

A pharmacist facilitator voiced some challenges around Performance Management Programme data, which was an area discussed by one of her counterparts at another PHO. She spoke of receiving large flat files of data provided by the DHB, from which the indicator measurements are drawn. As the data in the Excel spreadsheets was already aggregated to a certain extent, it was difficult for her extract the information she needed:

> ...for instance, one of the indicators is laboratory expenditure…and you’d expect the data that makes that up would be what each GP spends on laboratory – so it would be a list of all of the tests that the GPs ordered, and their costs, and that would be collected and then fed into the formula to make the indicator, but when you look at the file of data there aren’t any individual lines of tests, so… it’s basically no extra use to us than the report, that it’s generated from… …so…some of my work over the next month or so will be trying to see if we can get less aggregated data about that, if it’s possible… …we can [feed back suggestions], and for that project we’ve got a contact at DHBNZ - that’s an analyst that we can send feedback to… …They might just say “oh, we can’t send that”. We don’t know yet. (Pharmacist facilitator, Helen)

PHO 3 - Information processing needs/data issues:

Two GPs expressed some data processing wishes. One explained how it would be beneficial to be able to import a new patient’s historical notes into his PMS with them populating the appropriate places in the record:

> …it’d be nice…if we’ve all got electronic data that - we could transfer data better. For instance…we still get electronic data put down to manual paper, which we then scan in later or make a manual file from…Say we’ve got a patient and we’re going to transfer them from one practice to another. Often you

> end up doing a print out of the notes, so you've got electronic data going to a practice, which is presumably electronic, but with a set of manual notes… …you can [send it through a secure messaging service], but then it doesn't populate the correct fields, so you end up with this big file, which is useful, because at least it's on your system, but…if somebody's already done a problem list, and a medication list, and a results list, it seems...again, backward to not be able to have it repopulate it. (GP, Tim)

Another GP, Robert, said he'd love to have his notes typed, because he does not have the time to do it himself.

Cross case analysis - Information processing needs/data issues:

A range of issues were discussed by the pilot PHO-MS staff. Data duplication in the PHO systems, was identified by the IT manager and community nurse, with the former explaining that there was a strategy for dealing with the problem, although dealing with even simple issues was challenging. Human resources for regular reporting were said to be stretched at the PHO 1 management level, and the need for a website was also signalled. The need for reliable and complete data from government agencies and databases was explained by two managers, one of whom described the need for developers at the national level to work with health care end users to find solutions to problems. A screening co-ordinator, also described the need for more resources to assist practices to improve data management around cervical screening, and communications with national systems. Interviews from PHO 2 highlighted problems with the reliability of data from national systems, with HealthPAC being cited as an example, and which were said by a senior manager to have failed to keep up with developments at the PHO level, causing considerable frustration. However, it was acknowledged by both PHO managements that national level changes were planned, and also noted by PHO 3 management and discussed under the information gathering section. The pilot study IT manager emphasised the need for Ministry level decisions about information acquisition to involve specialist IT personnel, able to facilitate practice level reporting. Performance management spreadsheet data needed to be at a level of aggregation which allowed better utilisation, although the DHBNZ data was described as being otherwise well targeted and presented. It was also suggested by the PHO 2 pharmacist facilitator, that the Performance Management Programme data could be provided in a more useful format, as it was provided in a large flat file and aggregated in such a way that it was difficult to work with. Improvements, however, might soon be possible as the DHBNZ had provided an analyst contact for feedback. Another limitation was voiced by a senior manager who described practice management systems' vendors as slow to respond to the needs of the PHOs, who were keen to have access to integrated population level data. Additionally, reliable, 'clean' and accurate provider data, obtained from one system would be appreciated by the clinical manager who had invested efforts to develop screening templates to guide project staff to input data correctly. At the practice level, comments at PHO 1 focused on funding data issues regarding quarterly reporting. The PHO-MS was felt to be too slow in responding to problems, at one practice, and not able to provide adequate explanations of issues at another. At PHO 3, one doctor discussed how he would appreciate being able to import new patients' historical notes directly into his PMS system with the appropriate fields in the record being automatically populated with data, while another doctor, who did not use a PMS, related how he would like his notes typed as he did not have time to do it himself. Typing issues were important for this practitioner as they were prominent in his decision not to use a PMS himself, and such issues will be discussed further in Section 6.4.4.2.

When considering the postal questionnaire results (Table 6.18), PHO 2 gave a higher score (4.3) than PHO 3 (3.0) for their estimation of the extent of unmet information/information processing needs. For their estimation of the extent that unmet information needs could potentially be better satisfied using new computer systems, or improved use of existing computer systems, PHO 2 also rated higher (4.8) than PHO 3 (2.2). Also, 50% of PHO 2 responding practices provided information for the open ended question, against 16.7% for the latter PHO, suggesting that there might be greater information processing needs at PHO 2. These open ended answers for PHO 2 included:

- "Integrated access to ACC, hosp. discharges, PHO; Patient notes on the go; Lap-top/PDA potential exceeds reality". (Respondent)
- "Purchasing; payments - Need to get MYOB Accounting". (Respondent)
- "Training for nurses and Drs. using PMS systems - tools". (Respondent)

and for PHO 3:

- "Have not long ago converted to [the organisation's predominant PMS] from [another PMS] - so are still learning what is available". (Respondent)

Table 6.18: Questionnaire results for question 2 - Information processing needs/data issues

Questionnaire data relating to question area 2 (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally, and 7 = very much)		
Information processing/data issues:	**PHO 2**	**PHO 3**
Extent of unmet information/information processing needs	4.3 (0 - 7)	3.0 (1 - 5)
Estimation of extent that unmet information needs could potentially be better satisfied using new computer systems, or improved use of existing computer systems	4.8 (0 - 7)	2.2 (1 - 4)
Unmet information needs:	50% response	16.7% response

'Information processing needs/data issues' findings

Additional data processing needs and issues were explored, resulting in the following observations:

- There was a need for data duplication to be reduced.
- It was thought that Government agencies, such as HealthPAC, needed to provide reliable and complete data.
- National systems were said to need to keep up with changes at the PHO level, although it was acknowledged that improvements were underway.
- It was suggested that national level developers should work with health care end users, and Ministry level decisions regarding information acquisition needed to involve specialist IT personnel able to facilitate reporting at the practice level.
- Performance Management Programme data was needed to be provided in a more useful format, at a more appropriate level of aggregation, although moves towards improvement were acknowledged.
- Additional human resources for regular reporting were needed at the pilot PHO-MS.
- Reliable, clean and accurate provider data from one type of PMS was desired at PHO management level.
- There was a need for PMS vendors to respond faster to PHO needs for integrated population data.
- Quarterly funding data issues needed to be addressed, with timely PHO-MS support for practices having problems.
- PMS systems able to integrate new patients' historical notes automatically, populating the appropriate fields, were cited as desirable.

- Limitations in typing abilities prevented some doctors from utilising their practice systems fully.
- Improved systems integration was considered important.
- More training in the use of PMS systems was signalled as necessary.

6.4.2.5 Summary of question area 2: Information processing requirements

The management and practices in the PHOs studied required improved systems integration to be better able to gather needed data, and fulfil reporting requirements. The sharing of accurate, timely, well structured data was needed, both within the organisations and with external entities, and PHO managers needed PMS vendors to respond faster to their requirements for integrated population data. There was a need to equalise systems between different functional groups, for example, by improving the integration of mobile staff systems with base systems when off-site, the communications between PHO management and their member practices, and between GP practices. Access to available systems needed to be provided to all appropriate staff. High quality provider data from one type of PMS was desired at the PHO-MS level. However, where alternative PMSs were used, the need for increased user support was indicated. Some PHO-MS staff required increased support and training in the use of software and accessing needed data. Practice staff needed training and support in dealing with information overload, including that generated by PHO membership, with querying, and with initiating and maintaining up-to-date databases. They also signalled the need for support with quarterly funding issues, utilising their existing practice systems and their use of the Internet for information gathering, and data handling, for example, of historical data and for Read code entry. Systems improvements required reductions in data duplication, and national systems to be improved. This was acknowledged as underway at the time of the study. A need for system developers to work with health care end users, and IT specialists cognisant with practice level reporting, was expressed. PHO-MS staff required improved systems, including improved software, and systems were thought to need on-going updating with improved CDS. PHO-MS support provided for continuing improvements to data collection, and practice systems, were considered important and were also acknowledged, but PMS developers were thought to be slow in responding to practice needs, for example, for updated query bases. New computer systems, or the improved use of existing computer systems were considered by many to potentially facilitate a greater ability to access information required for CDM within PHO organisations.

6.4.3 Question area 3: Impacts of PHO establishment

What changes have the PHO made regarding CDS within the organisation (for management and/or providers?

6.4.3.1 Background to question area 3

Health professionals/managers have joined together in PHOs and in doing so experience new requirements for the processing of information used in decision making for patient care.

This question was designed to determine how PHO-MS are addressing issues of CDS within the organisation. It seeks to find out what changes the PHO have implemented or plan to introduce and how the process is/will be handled. This part of the interview provides answers to the question **'Can /how can IS support for CDM within PHO's be improved?'**

6.4.3.2 The impacts of PHO membership

PHO 1 (pilot) – Impacts of PHO establishment:

As the PHO was newly established, managers stated that improvements to systems were needed, and new data mining software was beginning to be introduced to the practices at the time of the study. An intranet existed for the PHO-MS but practices were yet not included, so this together with a website were planned for the future. Remote access to their system for management staff was just being organised. Interviews at two practices revealed that although some hardware and storage changes had been made, these initiatives were not driven by the PHO. However, one practice was about to have its systems updated as a result of encouragement from the PHO-MS and the knowledge that membership of the PHO would lead to increased reporting requirements. Despite resistance from the practice to purchase the PMS used by the majority of other member practices, the PHO-MS was providing some financial support for the changes. The final decision on a different system was due to staff reluctance to change vendors, and the belief that the changes would be simpler between products of one company. The doctor acknowledged:

> There's help financially, yes, they're going to refund some figure. I'm not sure what it is, but there's reimbursement for updating computers… …From [the PHO-MS]…an encouragement. (GP, Stephen)

One GP spoke of how his practice had recently been provided with new data mining software by the PHO:

> The other day they sent a thing round for us to load - some sort of [data mining] programme so that it [reporting] could be done on that, but I don't know if it actually worked. You might ask [Sonia] about that 'cos I think she's been in correspondence with [Nadia] about it… …I don't know the details of it but I think it's basically so that they can remotely – or, you know, automatically or remotely – suck up all this, sort of, [data] that they need, every three months… . (GP, Brian)

The practice had received support on occasions from the PHO's IT manager, Nadia, although the staff had varying opinions on the availability of the assistance. The administrator was greatly satisfied with help she'd received but the practice nurse suggested that it could be more readily available:

> We have [help] from [the PHO-MS]. There's an IT person that's available…. …She's hard to get hold of - she's busy all the time. (Practice nurse, Tracey)

The influence of PHO establishment was described by the clinical manager, Laura, who commented that the huge amount of restructuring the organisation was undergoing at the time was resulting in changes happening on an hourly basis. Regarding effects on data collection and reporting another manager explained some issues she was experiencing:

> …we've got [the IT Manager] and she's wonderful, but she's not…invincible… …she's just on her own doing a massive job… …I can do reports. We've got into a mode of how we manage, but those reports are not as robust as they could be…I don't believe… …You don't have the background data to…inform… …we know it's there - we know that it's being done, but if we had to justify it from an evidence based research thing, we can't get the data. (Population health manager, Gwen)

Further illustrations of data issues were given by Bridget, an administrator, who said that there had been a great increase in both their need to gather information and create reports. She cited the task of checking their patient register information with that from the PHO and from HealthPAC as an example of a new, and frustrating task, although it had resulted in a tightening up of their information, which she felt was a positive influence. This latter point was heard from others in the study, who said that although their workloads had increased a great deal and quarterly patient register reporting and checking was often a problem, they felt there were worthwhile results. For example one doctor explained:

> I guess we had to sharpen up our databases to make demographic data more accurate. That's probably the main thing as, you know, we had to get the register sorted out. (GP, Brian)

The effect of PHO activities on CDM in the organisation, at both individual patient and population levels, and the need for good population based data, was explained from the PHO-MS perspective:

> …clinical decision making, we kind of do [become involved with it], in that we put together the strategies that say a certain patient can be accepted onto a certain programme because they meet these criteria, so we are in actual fact affecting the care that the GPs give. I will use the sexual health project again [as an example]. There are certain criteria that the patients have to meet to be accepted onto that programme. If they fall outside of that criteria then they have to access that care either somewhere else, or… ...so it is not, it isn't direct patient information, because we don't deal directly with the patients, but we do affect clinical decision making…
>
> …[Information] affects…our planning for next year - You can see how the programme is being utilised currently, which affects how you plan for next year. It's a 'heads up' to say you know you're spending too much, or we may need to go in search of other funding because this problem is worse than we actually thought…It does actually affect how the GPs are able to do their jobs. We - now, to make policies that guide clinical decision making we need to go and do the research, so we go out and find all the journals and belong to all the professional bodies so that you can make a decision on how you are going to put together a particular project and who you are going to include, and again you get information from the DHB, from the Ministry of Health - you are looking at what the trends are in terms of population health so that you can put together an appropriate package. (IT manager, Nadia)

From the practice perspective, when asked if PHO membership had made any difference to the use of computer systems for the support of decision making in patient care, Bridget initially said it had not. However, she then voiced the opinion that although not a clinical decision support function, checking their patient register information had, for example, been useful in identifying unrecorded ethnicities. This had the potential to improve services targeting particular sections of the patient population. She also spoke of how the DHB were very supportive in terms of their immunisation programme with telephone and physical assistance, email and notices.

PHO 2 - Impacts of PHO establishment:

PHO establishment had brought about changes in the support the practices had been receiving for their systems:

> …the system was restructured when we changed from the IPA to the PHO and they were supported by [the IT Manager, Ethan] before, in the individual

> practices, but since the PHO developed, [he] supports PHO things in the practices, but they have to get their own practice support for their [systems]… …so that's quite a big, kind of philosophical shift... (Pharmacist facilitator, Helen)

This decision was discussed also by the clinical manager who, although not in the organisation at the time, thought that some practices had reasons for not wanting centralised systems support, although they were unlikely to have been the deciding factor:

> …I think for rural - like, we're totally different anyway, we need our support where we are. You know…it was pointless having someone here, when we've got IT guys up in our area… …I suspect rurally we didn't have a lot of influence 'cos we probably weren't accessing the IT guy down here that much anyway…That's my impression.

On the subject of how she thought things might have changed for the GPs since joining the PHO she elaborated:

> Oh, hugely. Hugely… … there's been a real big push for [the predominant PMS]... …I'm not a hundred percent sure actually [how many changed]. I think some of them - a lot of them were still on hard copy, you know, so, it was a real shift from hard copy and there [were] - the other ones, you know like at the practice I was at, that changed… …I think doctors tend to embrace stuff. They might not necessarily like it, but they'll go with it, and I think most of them, if you talked with them, they would say the IT stuff's actually made it easier for them. (Clinical manager, Wendy)

Urban practices located close to the PHO-MS were connected to it via a Wide Area Network (WAN) with some practices using fibre optic cables and others with microwave connections. However, remote rural doctors were not networked with the PHO-MS. The PHO-MS operated an intranet and a website but not all practices were able to access the intranet at the time. The IT manager, Ethan, had been looking at providing a low cost VPN for these practices but had been experiencing difficulties with the plan. At the time of the interviews the PHO-MS had purchased a smart form technology for member practices from the vendor of their predominant PMS, and were planning to update their data mining software, also from the same supplier, so they would be able to integrate directly with practice data via the forms.

One doctor spoke of not being influenced by PHO membership to upgrade their hardware as they already had a policy to improve their systems periodically and had updated prior to PHO establishment. However, the PHO had helped the practice to transfer to broadband:

> …I think you get onto broadband quite easily [with the PHO] and that's quite good…we always were interested in a broadband connection but we couldn't actually – it was too expensive in those days, but…the whole PHO was…on broadband, so, it's one reason we - reasonable rate… …and they just sort of paid the connection and …all the sort of…did the headache of connections etc. (GP, Ian)

Members of another practice had been influenced to change to the PMS used by the majority of practices in their area, also prior to PHO establishment, as it was seen as a way to facilitate linkages with other practices in the group which would save money in the future. As with other practices, their software had been updated periodically by their PMS vendor. Interviews at a third practice indicated there might be some difference in the support provided by the PHO-MS to rural and urban practices. One rural doctor was critical of the lack of support he felt practices received from PHOs. He also used a PMS system which was non-typical in his PHO and felt there were disadvantages to that situation:

> As far as I'm concerned PHOs receive money to put into IT technology and I don't believe that many of us practices have ever seen any of that… …not that I'm aware of… …you know, my belief is, O.K., well, if the DHB/PHO want information from practices electronically, then maybe they need to actually utilise some of that money to pay for those connections. That would be my thought on it.
>
> …any software development that seems to take place at the PHO level seems to be for [the predominant PMS], not for any other software, which I think is a mistake… (GP, Ross)

When asked if he had had any incentives with training, meetings, or finance he replied "Not PHO based". However, a practice nurse in a city practice, using the predominant PMS, felt that help was at hand if she had any problems producing information needed by the PHO:

> …usually they will provide someone if we've got a problem, they'll come and help us sort it out. (Practice nurse, Maria)

At the same practice the GP observed that PHO assistance with the purchase of systems and their encouragement of low users onto computer systems was helpful. He related how the PHO had assisted them with certain processes:

> We've just had to adapt…to the PHO. So, they've supplied us with forms to fill out. For example, the diabetic checks - they've given us forms…Then the Care Plus project they provide similar forms - preloaded documents, so we can do our Care Plus work… (GP, Ian)

Another GP mentioned other support provided by the PHO, such as that for continuing medical education, and incentives for achieving targets:

> I think the PHOs going to generate a bit more money if we can achieve the targets. So we're now going to sort of focus on those targets a little bit more, you know, like percentage of women who have a cervical smear and those that have mammography and immunisations. (GP, Blair)

He appreciated the aims of the PHO but had some reservations about progress, possibly in relation to co-ordination of activities within the organisation:

> I'm a bit, sort of, sceptical about the whole thing. I think that the targets that they're suggesting are good, and if we all move towards reaching these targets, and other ones are put in, it's a good idea, and I think most doctors are being competitive and they like to, sort of, do quite well in those things, so I think they will rise to it actually, but…six million dollars going in, and really I haven't seen anything come out of it really…you know, there is a lot of, sort of, people working separately.

Claire, the practice nurse, commented on PHO influence, saying that doctors now need more information, and that she felt that figures have to "look good". She perceived that things were dollar and percentage driven, but that in general there were some good ideas. The feeling that they were "jumping through hoops all day long" echoed comments made by the doctor. Cases of diabetes were considered to be identified "miles better", with the free annual check funded by the PHO being described.

In terms of differences PHO membership might have made to CDS within the organisation, a senior manager felt systems had been put in place which were contributing to improvements in that area:

> I guess we have established and formalised systems for capturing data and also for basing the decisions that we make on evidence…We formalised the development of initiatives so that instead of 'well this is a good idea – lets run with this' we've actually got some framework around it, and some monitoring and evaluation. We have targeted our activity on the most high need groups within our community as opposed to providing services to all people…so our most significant function has been to address the inequalities in health, particularly for Māori and Pacific Island people… …we are seen as – from the District Health Board – as an entity that has been successfully implementing some initiatives that are producing health gain.
>
> …at practice level…we've employed a practice facilitator who actually is going from practice to practice to support – we've got to try and get some consistency, and also…we've got someone on a fixed term contract at the moment who is actually assisting practices to - inputting their data and evaluating… . (Senior manager, Stephanie)

Additionally, a pharmacist facilitator, Helen, suggested that if the PHO could adopt new CDS tools, for example a cardio vascular decision support tool being developed at the time, it would be 'the ultimate' for her and would be a way forward.

PHO 3 - Impacts of PHO establishment:

As was the case with a practices in the pilot study, one of the interviewees in PHO 3 explained reasons for her practice rejecting the PHO-MS initiative to encourage all practices in the group to use the same PMS:

> …there was a deal going at the same time, but we'd just changed so…and [the doctor] was good…well, he said, "we probably should change", and I said "well, if we change I'm out of here"… . (Practice nurse, Carrie)

Some of her additional comments on the subject can be found in the 'Barriers' section, as an example of staff resistance. The PHO-MS provided considerable support for use of the predominant PMS, including a financial contribution towards the cost of a new system, and a trained staff member available to assist practice staff in its adoption, both before and after its installation, and in addition to the training provided by the vendor. As several practices retained use of another system, support was also available from another manager, although this was usually provided by telephone. The IT team were currently developing a new website with intranet and extranet facilities to enable the practices to connect to the site. Other recent initiatives had been to provide a free system and security assessment for each practice, and offer to contract the provision of day-to-day systems support from their IT team who were variously qualified by the PHOs main PMS vendor, in the installation of a secure commercial VPN service, and in Microsoft security measures. An IT manager, Garry, was surprised this offer had only been taken up by two practices so far, and lamented that "…80% of our practices have got no security at all…", and were "…doing their own thing" for system support. He felt that cost and previous bad advice from commercial IT suppliers, had been issues for them in this area, and was hopeful that more practices would take up the offer in time. The PHO-MS was also newly funding a secure commercial VPN security service, smart forms technology, and a new PMS patient health status interface for its practices, and the IT team had purchased new data mining software as they were imminently taking over data processing from an outside contractor. Some effect of these moves on the provision of improved CDS in the organisation was described by a service manager, Sally:

> …historically it might have taken up to ten working days to get a chem. number or a special authority number back for a patient. Now it's five seconds once you've got everything in the right places……[so] we're funding a secure commercial VPN service… …That's like $130.00 per month on-going, plus hardware installation…We do other things like [introduce smart form technology] - we've purchased the licensing, so we've enabled practices to be able to have that functionality, as well as ourselves - and efficiency - and another thing we've signed off on is…[a patient health status interface]…I totally believe it will help practice teams to do their job better… …and…we've been approached to see if we want to be a part of the [Decision Support System] pilot…it's a systematic tool to enable practices to identify and then deliver cardio-vascular risk assessments to their patients, in their practice… …and we'll get money with that as well. We'll fund the practices through that process too… …and we'll provide support to practices - that will be my role...We'll be going to our practices with it and asking them for expressions of interest with the delivery of it, so the leaders will get it… . (Service manager, Sally)

Discussing how their workloads had changed under the PHO, one practice administrator explained that her practice had taken on new staff to cope, but as with others she felt there were benefits:

> …everything you do is…accountable. You know, you have to account for…like…minor surgery – any money you get you have to show that it has all been put in the right places. I think it's good. I think it is very fair…
>
> We've had to do a lot more work, but we do have a lot of help from the PHO to do it, and support. We've had to introduce all the policies, the health and safety policies and complaints, privacy, infection control, incident reporting, and all of those procedures they've helped us with… . (Practice administrator, Zoe)

Cross case analysis - Impacts of PHO establishment:

The picture which emerged from PHO 1 (the pilot) was one of an organisation coping with fast paced restructuring, attempting to provide management service staff and providers with IT support with limited staff resources. The PHO-MS was changing rapidly with new positions and organisational structures signalled for the near future. Data collection from practices was being automated with new software, and all practitioners were being encourage to use the same PMS, although this was not entirely possible at the time. This was also the case in the other two PHOs, where neither had completely succeeded in establishing the use of a single PMS system throughout their organisations despite encouraging and supporting their practices to make the changes. In all three PHO's a few practices retained the use of alternative PMSs. Pilot study practice staff had experienced increased workloads, especially in the run up to PHO establishment and, although they were coping with increased reporting requirements were anticipating greater demands in that area soon to be forthcoming.

Practice staff at PHOs 2 and 3 also reported increased workloads since joining their PHO, but several acknowledged that they could see benefits emerging. However, some doctors interviewed were critical of PHO activities, feeling that they had yet to experience any benefits. The provision of IT systems support being organised privately by each practice was similar in PHOs 2 and 3. The decision by PHO 2 practices to purchase local IT support for their own computer systems, was thought to have been partly a result of their geographic spread. Distance issues seemed to have influenced the level of support provided by the PHO-MS, for PHO related IT issues, which appeared to have been minimal for some remotely located practices. The provision of a cost effective VPN was proposed in PHO 2 for those remote practices which were not networked with the PHO-MS at the time, as were more local practices who also had access to the PHOs intranet. Support was also being provided for new data collection software for practices with the predominant PMS, and other types of support were also evident, such as the provision of a travelling practice facilitator. PHO 3 was also funding a range of new IT products for its practices which would improve data collection and reporting, and were also funding a secure commercial VPN service and a patient health status interface for all its practices. Support for practices' use of PMSs in PHO 3 included a comprehensive introduction process, in addition to help with query building. The IT team at PHO 3 had recently offered to provide a practice systems support service, under contract with interested member practices, with the hope of bringing them all to a similar level with their IT.

The postal questionnaire results (see Table 6.19) indicated that Practices in PHO 2 had made more changes to their hardware and software than those in PHO 3, with the latter reporting greater assistance with changes from the PHO, either of a technical or financial nature. Both practice groups gave a high mean score in reply to being asked if their data collecting and reporting needs had increased since joining the PHO, with PHO 3 practices appearing to be more confident of their abilities in fulfilling those processing needs using their computer systems. Practices in PHO 2 scored highest for how they had been helped by the PHO in the reduction of barriers to the use of computers in the support of CDM in the practice, but the reverse was observed for the question which asked about the extent to which the practices receive more information supporting CDM since joining the PHO, where PHO 3 scores highest. An open ended question specifically asking what information from the PHO is useful in CDM provoked no comments from respondents in PHO 3, but two responses from PHO 2 practices:

- “PHO is [organisation’s predominant PMS]. I'm not” (Respondent).
- “Our PHO has the Intranet but rural practices have no access to it. The PHO provides very limited support etc. into our practice - they are more of an organisation that filters our funding than an organisation that provides services/benefits to the practice on an operational level” (Respondent).

Under ‘Comments’ at the end of the survey, one practitioner from PHO 2 stated:

- “PHO is unsupportive financially and emotionally of my practice” (Respondent).

and another in PHO 3 wrote:

- “1) Lack of training/instruction in beginning, and 2) Cost, and next year Vista - then more hardware. I think DHB should have its own software which we could all use…” (Respondent).

Further results shown in Table 6.19 referring to how information useful for CDM is communicated to practices within their organisation, from both their management services and other providers, were higher for all modes of communication named in the list for PHO 3 practices, with unspecified ‘other means’ being the only category scoring higher for PHO 2. These results point to the possibility that PHO 3 practices experience a greater level of communication through a variety of modes in their organisation.

Table 6.19: Questionnaire results for question 3 – Impacts of PHO establishment

Queationnaire data relating to question area 3 (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally/hardly ever, and 7 = extensively/much more/fully/mostly)		
	PHO 2	**PHO 3**
PHO Influence:		
Extent to which the practice has needed to do more data collection /reporting, since joining the PHO	6.3 (5 - 7)	6.7 (6 - 7)
Extent to which the practice been able to fulfill its information processing needs using its computer systems, since joining the PHO	4.7 (1 - 7)	6.8 (6 - 7)
Extent to which the practice receives more information which supports clinical decision making, since joining the PHO	3.0 (0 - 7)	4.5 (1 - 7)
Extent to which PHO membership has resulted in the practice changing its computer hardware	4.3 (1 - 7)	2.8 (0 - 7)
Extent to which PHO membership has resulted in the practice changing its computer software	4.0 (1 - 7)	3.0 (0 - 7)
Extent to which the PHO has assisted the practice with any changes that have been made (e.g. technical or financial)?	2.3 (1 - 6)	4.7 (0 - 7)
Extent to which PHO membership has helped in the reduction of barriers to the use of computers in the support of clinical decision making in the practice	3.3 (0 - 7)	2.7 (0 - 6)

Information from the PHO which is useful in clinical decision making (% response)	33.3% response	0% response
Extent of communications by different methods to practices from PHO-MS:		
Secure messaging e.g HealthLink	3.0 (0 - 7)	5.3 (1 - 7)
Fax.	2.7 (0 - 6)	5.0 (1 - 7)
E-mail	2.3 (0 - 5)	4.8 (1 - 7)
Telephone	2.0 (0 - 4)	4.8 (1 - 7)
Post	2.2 (0 - 5)	4.5 (1 - 7)
Face-to-face	2.0 (0 - 5)	4.2 (1 - 7)
Other means	3.0 (0 - 6)	1.0 (1 - 2)
Extent of communications by different methods to practices from other practices/providers in the PHO:		
Post	3.2 (0 - 6)	5.3 (2 - 7)
Fax.	2.7 (0 - 6)	5.3 (4 - 7)
Secure messaging e.g HealthLink	2.5 (0 - 7)	5.3 (2 - 7)
Telephone	2.7 (0 - 6)	4.7 (3 - 7)
E-mail	2.2 (0 - 6)	5.2 (4 - 7)
Face-to-face	1.4 (0 - 3)	2.6 (0 - 7)
Other means	3.0 (0 - 6)	0.5 (0 - 1)

‘Impacts of PHO establishment’ findings

This question explored the effects of PHO establishment on its member organisations and management services, and how the use of computers for CDS might have been influenced in the organisation. Observations from the research are listed below:

- PHO-MS and practice staff needed support with the establishment of new organisations and fast paced restructuring exercises e.g. early IT support within the organisation.
- A range of reasons existed for member practices not adopting the predominant PMS.
- Practices were challenged by pre-organisation establishment tasks, and increased workloads from greater data collecting and reporting needs.
- Increased resources were needed for equalising practice level IT and supporting its use.
- Some remote rural practices appeared to need more resources and support from PHO-MS, including visits from support staff.
- PHO-MS funding for the implementation of new, and the improved use of current computer systems, beneficial for CDS, was evident.

- There was a need for increased support for PMS users, including when new systems were introduced.
- More support was needed for practices not using the predominant PMS e.g. with query building.
- There were indications that there would be benefits with the increased use of available modes of communication within PHOs.
- All three PHO-MSs were implementing the use of technologies which could improve eCDS within their organisations.

6.4.3.3 Summary of question area 3: Impacts of PHO establishment

PHO-MS funding for new systems and support for the use of current systems with the potential for increased eCDS in the organisation, was provided by all three PHOs. However, extra resources, including in the area of IT support, appeared necessary where organisations were newly formed. Practices had increased workloads in preparation for PHO establishment, and from new, on-going reporting requirements, and appeared to continue to need added resources to fulfil PHO requirements. New reporting activities necessitated support for some PMS users, for example, with query building. Each PHO-MS had attempted to equalise its member practices' systems, and had applied resources to the task, although none had succeeded in having all its practices using a common system. A variety of reasons were given for the use of non-predominant systems which indicated the need for different strategies and support to be applied in these practices by their PHO-MS. Remote rural practices appeared to need added support, and there were indications that an increased use of available methods of communication would be helpful in fostering eCDS.

6.4.4 Question area 4: Barriers

Do you perceive any potential barriers/enhancers to the improved use of IS for clinical decision support in your work?

6.4.4.1 Background of question area 4

Barriers to the adoption/use of computer software/tools for the support of CDM have been identified in health care literature (Johnston et al., 2002; Short et al., 2004; and Wells and Jackson, 2005).

This interview question explores if health professionals/managers consider there are factors which act as barriers or enhancers to their being able to utilise the potential of computer systems to support their decision making for patient/patient population care. Where barriers/enhancers exist, the reasons for their effect will be identified. This part of the interview will help to answer the following: **'What factors influence the use/further use of IS for decision support by PHO health professionals/ managers. What do PHO health professionals/managers think about factors influencing their use of IS in clinical decision support?'**

6.4.4.2 Potential barriers to eCDS utilisation

PHO 1 (pilot) - Barriers:

Barriers to the use of computer systems for CDS were experienced by both PHO-MS staff and member GP practice interviewees. During interviews issues affecting both groups of contributors were discussed, and involved cost; system speed; software; credibility; training; knowledge of appropriate systems/tools; skills and degree of comfort using CDS programmes; ability to fully utilise PMS features; On-going systems support; time; privacy; security; and access to systems or data. Training issues commanded many comments such as those from a senior manager, Evan, who spoke of how, in future, he would like to develop minimum standards in the organisation, including those for training, as it would give them benchmarks to work to, and another who expressed her feelings about training in the practices:

> …that [training] is a big fat barrier…because especially for practice management systems in the practices, if they are not willing to pay for the training, especially at the installation point, then they are only going to use it as much as they have been trained to use it… …when the training is done well, and that is part of my role as well, is to do the training for the practices and within the [PHO-MS], I have seen huge leaps by some of the staff here once they have been trained on how to use things like their cell phones, how to use their computers better, how to use their e-mail better. (IT manager, Nadia)

Additionally, PHO-MS staff discussed issues involving hardware, fear of using computer systems, and the effects of the fast changing organisational environment. The latter issue was discussed by an interviewee who described challenges being experienced at the time which were impacting her work as a community worker:

> I personally don't believe I do [get enough on-going systems support]. It's always very rushed, and it's almost like this whole service has got the dregs of what [PHO-MS] come up with, but that's just coming from my perspective…. …and it just shows the change in nature, and how [the PHO-MS] has found the PHO [establishment] has affected them - maybe that's the way it's affected me in this service... …they're just so damned busy…and it's not because they're choosing that, it's just the nature of the change in environment that they're

> under, which, I guess, I've got a part of that, which is nice, but I do feel for them. (Community nurse, Kelly)

GP practice interviews revealed issues connected with typing, staff resistance, information overload, intrusiveness of computers, and vendor support. Criticisms of services provided by software vendors revolved around expense, speed of responses to user requirements, feedback on requests for assistance and problems originating from competition with other vendors. One interviewee voiced the following comments regarding the cost of vendor support:

> …if something goes wrong with the system you have to hire one of their people – it costs you about two and half grand…[to] fly them down here.
>
> …you can't fly people down at two and a half grand a week, just to have a look at something small on the server…and they don't like telling you how to fix it on the 'phone... . (Administrator, Bridget)

PHO 2 - Barriers:

Both PHO-MS staff and member GP practice interviewees in PHO 2 experienced barriers to the use of computer systems for CDS. The following issues affecting some members of both groups were discussed during interviews: Cost; software; credibility; training; ability to fully utilise PMS features; on-going systems support; privacy; access to systems or data; information overload; and vendor issues. Privacy issues were highlighted in a PHO-MS interview where a senior manager voiced the opinion, heard elsewhere, that questions around the use of personal information should be aired in the public arena:

> …I think there are some challenges ahead, there's no doubt about it…from our point of view it's unidentifiable data, but, you know, from a research perspective, are we taking liberties on how we use the data that we have in our systems, because we want more from it?…for diabetes for instance - not only are we collecting that data from, say, the annual checks and things, but we're also wanting to analyse it, and determine from it, basically, the status of our diabetic health - of our patients… …obviously the administrator that's pulling the data has some coding system, but I guess she knows who those people are. Someone has to know who it is 'cos that's how we – you know, it's like, we can search through your NHIs…I guess it's that ethical issue of…say you've got 30 patients that clearly haven't visited a doctor for a year and their…health assessment shows some appalling health outcomes, do we then – because we can identify those people – do we then make an approach to them…? …that's the kind of stuff that we can do, but is it our right to do it? I don't know…but you can't ask consent until…you know, on contact with them. I mean we do that with the 'Did Not Attends', where we had followed them up, and obviously they had to consent as to whether they want us to – to be engaged with us…we're always sensitive about that… . (Senior manager, Stephanie)

Hardware issues were described by the IT manager at the PHO-MS, Ethan, who explained the challenges surrounding the organisation of cost effective secure network connections for their rural practices, where attempts at providing a similar service to that employed with closer GPs had been hampered by a commercial provider. Other issues were described by practice interviewees and included system speed; knowledge of appropriate systems and tools; time; security; typing ability; staff resistance; intrusiveness; and reading from computer screens. Two nurses at different practices, Claire and Carla, felt that using a computer was intrusive when working with patients. One of them also did not like reading information from the computer screen, and a GP at her practice described his feelings on the latter issue:

> …I have to say I still find reading stuff out of a text book or off a medical journal, or something paper, for some reason, seems to be easier than reading it off the computer screen, and I can't answer why. I've got absolutely no idea, it doesn't make sense to me…I seem to retain the information better. I prefer reading stuff out of a book than I do off a screen, even though I've used a computer now for, you know, seventeen or eighteen years. (GP, Ross)

PHO 3 - Barriers:

Issues providing barriers to the use of computer systems for CDS, discussed during interviews with PHO 3 management and practice personnel, included cost, software, training, on-going systems support, privacy, and security. A senior manager, Carol, and IT manager, Garry, at the PHO both felt that costs issues were considerable with Garry describing cost as the biggest barrier to improved CDS in the organisation. He also expressed the concern that many of their GP practices had security issues and was surprised that most of them had not taken up his offer of a service contract for their systems, which included security measures:

> I've done an audit of all the GPs practices in terms of what they've got, their hardware, software, how secure are they, what systems are they using right now, every detail. Now, clearly 80% of our practices have got no security at all, and they were clearly shocked…and I've been with - through lots of meetings - government associated - with me saying there's security but - it's not too hard to get in there, anyway, but, the question I have is that everyone is doing their own thing. They're all individual businesses which is fine, but they're all doing a separate thing. (IT manager, Garry)

One practice nurse, Carrie, had unsuccessfully tried to install spam filtering software on her computer but had not contacted anyone for assistance. PHO-MS staff mentioned hardware; systems speed; vendor related issues; and skills/degree of comfort using CDS programmes. Garry had experienced a vendor related issue having been in talks for over a year with three major companies, and had been frustrated that issues, including licensing laws, prevented him providing an integrated system for all the GPs complete with all their security needs, for an acceptable cost. Practices spoke of issues around their knowledge of appropriate systems/tools; time; typing ability; staff resistance; information overload; and ability to fully utilise PMS features. One doctor felt his PMS was lacking in functionality but admitted that he had limited knowledge:

> …we're looking at the population much better, but again the good, actual decision support, should actually remind you of that when you actually see the patient. There should be something coming out at that level saying that "this lady's blood pressure is too high", and there may be good reasons for that, you treat individuals not diseases, but it should be there in place to remind you… …They're not [providing it] there now…

When asked if the system had the functionality to be set up to do that he answered:

> …Well, I never know, because you never know how much of the system you don't know, which is always an issue. Often these systems can do more than you actually know. We are getting [a patient health status interface] coming, which will put things like that up in front of your face. (GP, Stewart)

The issue of staff resistance was illustrated at one practice where a staff member spoke of her experiences in adapting to a new system and consequent reluctance to change to another PMS for alignment with PHO strategy. This had influenced decisions in her practice:

> They [the PHO-MS] want us all to be on [their predominant PMS], 'cos it's easier, but I refuse to change, so there's only two practices in the PHO that are on - or three - that are on [a different PMS]. Actually, it must drive them mad… …We'd just gone onto [our PMS] and it had taken seven months to get that sorted, and then they turned around and said we'd like everyone on [their predominant PMS], and I said "no way". I'd just had a months stress leave and there was no way I was going through that……and [the PMS vendors] were hopeless. In the end I was screaming there down the 'phone, and they sent someone down to sort us out, but, it was terrible… (Practice Nurse, Carrie)

Cross case analysis - Barriers:

Training:

Lack of training was seen as an important barrier by both PHO-MS and practice staff at all three PHOs, with the limited amount of vendor training experienced by most practice staff being cited as one problem. Despite PHO-MS for both PHOs 2 and 3 providing training support for practice staff, the need for more support was still evident. For example, one rural practice staff member thought they had not been visited by anyone from PHO 2 management for 15 months, a problem which was potentially due to their location.

Cost:

Cost issues were cited by both PHO-MS and practice staff throughout all three PHOs. Funding, and software support related costs were important to PHO 1 management, with software support related costs also being a large concern for their member GP practice staff, and those of PHO 2. IT staff at both PHO 2 and 3 complained of vendor related issues surrounding their efforts to provide cost effective networks for their member practices. Despite funding being provided, and IT support being available to PHO 3 practices, the costs involved with changing PMS systems and maintaining systems were described as problems at one practice.

Hardware:

Practitioners interviewed for the study did not rest a great deal of emphasis on general hardware issues, and several related that the acquisition and replacement of hardware is a necessity which has to be accounted for in today’s practices. Although the cost of systems was seen as high, the fact that hardware was much cheaper than in former years was acknowledged. Some associated aspects of hardware, such as systems speed and cost are elaborated elsewhere under those headings. PHO-MS IT staff were more vocal than practice staff about hardware issues in general, and spoke about reluctance by practices towards system upgrades in PHO 1, and network issues within their organisations in PHOs 2 and 3. It is likely that practice staff were less likely to express concerns about their hardware, being inclined to retain systems they were used to and only upgrade when they judged it necessary.

Knowledge of appropriate systems/tools:

A range of health professionals expressed the desire for more knowledge of systems and/or tools which could assist them in their information gathering activities and included PHO administrators at PHO 1, and GPs and other practice staff at PHOs 2 and 3. The phrase “I don’t know what I don’t know” was heard several times.

Time:

Many people made comments about time issues in their work and it was felt that certain computer related activities were time consuming extras which either could not be accommodated, or had to be contended with under pressure. Practice staff in all three PHOs were vocal on these issues, with PHO-MS staff also in PHO 1 voicing concerns.

Skills and degree of comfort in using CDS programmes:
Skills and comfort in using CDS programmes were considered as potential problem areas by management and practice staff in the pilot PHO, and the PHO-MS IT manager emphasised the importance of good training for practice staff.

On-going systems support:
The presence of on-going system support was said to be an issue in all groups interviewed. Vendor issues, such as the availability of their support and their responsiveness to user requirements, were cited as important barriers to the extent that they could be considered as an independent barrier category. The need for personal contact with a support person was also important. Difficulties associated with using a different PMS system from others in the PHO were explained by one interviewee in PHO 2, whilst a PHO 3 IT manager was surprised that his recent initiatives at providing a support service for members had only been taken up by one practice, with cost being cited as a possible reason. Cost issues connected with systems support for practices were highlighted by one staff interviewee who stated that on occasions, in preference to employing expensive support, she had been helped by her young adult children.

Credibility:
Credibility of information is related to how trusted the source of that information is, and how credible, evidence based and appropriate, is the information itself. Various aspects of credibility were discussed by PHO-MS staff and GP practice members of PHOs 1 and 2. Challenges surrounding data accuracy were mentioned by PHO-MS staff and doctors at both of these PHOs, and bias from sources of patient information leaflets were concerns mentioned by one PHO 1 doctor, with the appropriateness for general practice of some clinical algorithms, mentioned by another from PHO 2.

Utilisation of the PMS:
Some GPs still use a very limited amount of their PMS systems' functions, but it was interesting to note that these doctors did not necessarily fit into the 'late adopter' or 'laggard' categories of innovation adopters. It was evident that reasons for a lack of utilisation of PMS systems varied between different practice user groups with a range of barriers being implicated, such as limited typing skills, upgrade costs, early systems'

teething problems, security, time, training, and fear of or reluctance to experiment with the system, all being important.

Typing skills:

Although not a problem for many, typing issues were mentioned by doctors interviewed in all three PHOs. Keyboard proficiency and health (e.g. related to OOS), quality of records, GP/patient interaction, and speed, time, and cost issues, together with the influence of typing skills on legal issues were all discussed. Quality of records was mentioned as a typing related issue by two doctors in different PHOs, as were medico-legal issues. One GP who did not keep electronic patient notes described his concern that his slow typing skills would render him unable to make his notes detailed enough to support potential legal challenges. The use of voice recognition software was mentioned by several doctors as a technology to be considered although few knew anyone who was currently employing it in general practice. Current systems were acknowledged as greatly improved, with the introduction of pre-written sentences and typing templates, by a doctor who was soon to update his system after 10 years. However, a doctor at another PHO who did not use a practice computer himself voiced arguments against such tools.

Privacy and security of data:

Privacy issues, which could potentially hamper the better use of computer systems in CDS, were of concern to all groups interviewed. In some cases this resulted from either too many or too few security measures, as well as concerns for the privacy of patients' data. Privacy issues concerning practice financial data and prescribing statistics were also raised. Security issues were of concern to some practice staff at each PHO, and also management staff at PHOs 1 and 3.

Software:

All interviewee groups cited software issues as barriers. Some PMSs were found to have functions which would not work or some areas where user needs were not being met. Format and flexibility issues were mentioned, and it was said that some PMS functions available did not seem to be used a great deal. Many problems cited by PHO-MS staff and members related to how vendors interact with each other, and included the lack of communication with each other when changes made to one vendor's system could impact another's. Vendors were said to exhibit a lack of ownership of problems generated by system updates, and issues with data could be unresolved for a great length of time. They were also found to be slow to respond to user requirements.

System speed:

System speed issues related to practice systems' ages, configuration, IT support, and location. They have the potential to affect the implementation of programmes, interfere with individuals' abilities to process data, and possibly negatively influence interactions between staff. Such issues were discussed by management and practice staff of the pilot PHO, practice staff at PHO 2 and management staff at PHO 3. One rural practice staff member in PHO 2 had difficulty running queries as her entire practice network slowed down when one was run, inciting complains from fellow workers, and the lack of broadband coverage for some rural practices was cited as a problem by PHO 3 management.

Staff resistance:

Staff resistance was illustrated from different perspectives. Two GPs in the pilot PHO explained their dislike of using email, whilst at another pilot practice and one in PHO 3, interviewees explained how resistance by staff to the introduction of a new system could, and had, influenced decisions made by the practice owner.

Other issues (information overload; access to systems or data; vendor issues; fear; computer intrusiveness; cultural insensitivity; reading from screens; and the fast pace of change)

Additional significant barriers were identified by individuals in the study such as: information overload; restrictions on access to systems or data; vendor issues; fear of using the computer; intrusiveness of computers in consultations; cultural insensitivity of using computers in certain situations; difficulties in reading information from the computer screen rather than printed sources; and effects of fast paced organisational changes. For example, many people complained about the barrage of information they receive on a daily basis, both by post and electronically. However, one source in particular was mentioned frequently, that being the number of alerts generated by the pharmacy support component of their PMS, which was said to be so intrusive that many GPs were said to turn the function off or ignore the messages. Also, there were several instances where interviewees related that they had problems accessing systems or data which would help them in their work. Reasons given included the physical location of computers, staff interactions, and simple things such as access to email lists.

Quantitative data provided in Tables 6.20 and 6.21 indicate that the experience of barriers to the use of computers systems in CDS differed between practices in PHO 2 and PHO 3, with some being more of a problem to one group than the other. Table 6.21 shows the barriers rated by each PHO practice group in descending order of importance, together with their scores. Cost and hardware, scoring 6.8 and 6.4 respectively, rated highest for PHO 2 but were of much less importance in PHO 3 where they both scored 2.8. There is a possibility that most hardware issues related to costs, such as those due to replacement and maintenance, rather than specifically technical issues, which could explain these results. Similarly contrasting results were noted for training and security issues which topped the list of barriers for PHO 3 with scores of 5.2 and 4.8, but where PHO 2 rated training at 4.4 and security issues at a low 2.4. Respondents from PHO 2 gave a higher mean score for barriers than did those for PHO 3, possibly indicating a higher level of difficulties experienced by that group. Interviews provided insights into additional barriers not included in the questionnaire, which were discussed above. Finally, an open ended question asking about other barriers prompted one response from a PHO 3 practice as follows:

> We don't feel we get worth while support from [the PMS vendor] for the fees we pay monthly! (Respondent)

Table 6.20: Questionnaire results for question 4 – Barriers

Questionnaire data relating to question area 4 (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally, and 7 = very much)				
Issues providing barriers to the use of computers systems in clinical decision support:	**PHO 2**		**PHO 3**	
	Mean and range	**Ranking of barriers**	**Mean and range**	**Ranking of barriers**
Training	4.4 (0 - 7)	Joint 4th	5.2 (2 - 7)	1st
Cost	6.8 (6 - 7)	1st	2.8 (0 - 7)	Joint 11th
Hardware	6.4 (5 - 7)	2nd	2.8 (0 - 7)	Joint 11th
Knowledge of appropriate systems/tools	4.4 (0 - 7)	Joint 4th	4.5 (2 - 7)	Joint 4th
Time (workload)	4.4 (0 - 7)	Joint 4th	4.2 (1 - 6)	Joint 6th
Skills/degree of comfort using clinical decision support progs.	4.0 (0 - 7)	Joint 5th	4.3 (2 - 7)	5th
On-going systems support	3.8 (0 - 7)	Joint 6th	4.5 (4 - 6)	Joint 4th
Credibility of information who is responsible for the decision)	4.5 (0 - 7)	3rd	3.7 (0 - 7)	8th
Ability to fully utilise PMS features	3.8 (0 - 7)	Joint 6th	4.2 (2 - 6)	Joint 6th

Typing ability	3.6 (0 - 7)	Joint 7th	3.8 (1 - 7)	7th
Security	2.4 (0 - 7)	Joint 11th	4.8 (1 - 7)	2nd
Privacy	2.4 (0 - 7)	Joint 11th	4.7 (1 - 7)	3rd
Reading material on the screen	3.8 (0 - 7)	Joint 6th	3.2 (1 - 7)	10th
Software (in general)	4.0 (1 - 7)	Joint 5th	2.7 (0 - 5)	12th
Computers being intrusive during consultations	3.0 (0 - 7)	9th	3.5 (1 - 7)	9th
Software - Functionality	3.3 (0 - 6)	Joint 8th	2.8 (0 - 4)	Joint 11th
System speed	3.6 (1 - 7)	Joint 7th	2.3 (0 - 4)	14th
Software - Content (order, level of detail)	3.3 (0 - 6)	Joint 8th	2.5 (0 - 4)	13th
Staff resistance	3.6 (0 - 7)	Joint 7th	2.2 (0 - 5)	Joint 15th
Software - Flexibility/ease of adjustment	3.3 (0 - 6)	Joint 8th	2.2 (0 - 4)	Joint 15th
Software - Format (appearance)	2.8 (1 - 6)	10th	2.2 (0 - 4)	Joint 15th
Other barriers	0% response		16.7% response	

Table 6.21: Questionnaire results for question 4 – Barriers : In descending order of importance to each PHO

Questionnaire data relating to question area (Mean values of PHO practice answers on a scale where 0 = not at all, 1 = minimally, and 7 = very much)			
Issues providing barriers to the use of computers systems in clinical decision support (in descending importance in PHO 2):	**PHO 2**	**Issues providing barriers to the use of computers systems in clinical decision support (in descending importance in PHO 3):**	**PHO 3**
Cost	6.8	Training	5.2
Hardware	6.4	Security	4.8
Credibility of information who is responsible for the decision)	4.5	Privacy	4.7
Training	4.4	Knowledge of appropriate systems/tools	4.5
Knowledge of appropriate systems/tools	4.4	On-going systems support	4.5
Time (workload)	4.4	Skills/degree of comfort using clinical decision support progs.	4.3
Software (in general)	4.0	Time (workload)	4.2
Skills/degree of comfort using clinical decision support progs.	4.0	Ability to fully utilise PMS features	4.2
Ability to fully utilise PMS features	3.8	Typing ability	3.8
On-going systems support	3.8	Credibility of information who is responsible for the decision)	3.7
Reading material on the screen	3.8	Computers being intrusive during consultations	3.5
System speed	3.6	Reading material on the screen	3.2

Typing ability	3.6	Cost	2.8
Staff resistance	3.6	Hardware	2.8
Software - Functionality	3.3	Software - Functionality	2.8
Software - Content (order, level of detail)	3.3	Software (in general)	2.7
Software - Flexibility/ease of adjustment	3.3	Software - Content (order, level of detail)	2.5
Computers being intrusive during consultations	3.0	System speed	2.3
Software - Format (appearance)	2.8	Staff resistance	2.2
Security	2.4	Software - Flexibility/ease of adjustment	2.2
Privacy	2.4	Software - Format (appearance)	2.2
Other barriers	0% response	Other barriers	16.7% response

Comparing the results above with those from the pilot study GP practices (PHO 1) shown in Appendix 5, there is agreement that the highest scoring barriers are generally non-technical in nature (Engelbrecht et al., 2006), relating mostly to organisational issues. The majority of pilot study practice respondents (88.9%) reported a moderate or strong rating for both cost and time issues as barriers. Training was seen by 77.7% of practices to rate moderately or strongly, and skills in using CDS programmes and credibility were rated similarly by 75% of respondents. Technical issues connected with hardware, software and system speed were reported to be less important as barriers. The ranking of barriers from the pilot study, in terms of the most important five, closely matches those shown in Table 6.20 which gives a ranking of the combined results from PHOs 2 and 3, the only exception being the high rating for hardware due to the score from PHO 2. As mentioned earlier, the result for hardware could be due to a relationship between hardware and cost issues, and therefore more appropriately considered as an organisational or funding issue rather than a technical one.

‘Barrier reduction’ findings

Many barriers to the improved use of computers in CDS within the PHO environment have been presented through this analysis, and a list of research findings is provided below:

- There were cost issues connected with hardware and software maintenance and support within PHOs.

- PHO-MS funding of secure messaging services, or plans to provide cost effective private networks were evident, and their continuation considered important.
- Health department data quality improvements were anticipated and acknowledged as soon to be forthcoming.
- Practitioners wanted to be able to access quality data sources through available technologies.
- Additional training in the use of software and systems was needed by both PHO-MS and practice staff. Practice staff required more support from PHO-MS or vendors with PMS issues.
- Most practitioners felt that increased information sharing could potentially impact patient privacy.
- Many practices did not have a high level of IS security.
- Managers and practice staff wanted to have a greater knowledge of systems and/or tools which could assist them in their information gathering activities, and increased skills and comfort in using CDS programmes.
- Both PHO-MS and practice staff wanted more time to accommodate additional computer related tasks.
- Interviewees stated that software vendors should respond faster to user requirements, communicate better with each other when changes made to one vendor’s system could impact another’s, and exhibit more ownership of problems generated by system updates.
- Practices experienced a range of inhibitors to their improved use of their PMSs.
- There was a need for support with systems to be on-going throughout the PHOs. Personal contact with a PHO-MS support person, or in-house IT specialist was welcomed, and vendor support needed to be more available.
- Improved IT resources were required to equalise system performance to a similar, high level between PHO practices.
- Easily configured speech recognition software was mentioned as possibly beneficial to practitioners facing typing limitations.
- Staff resistance to the introduction of new computer systems were found be due to various reasons, requiring a range of solutions.
- Information overload was experienced by practice staff as a result of spam, and prescribing software which provided too many alerts and was often ignored or switched off.

- Organisational issues, or insufficient training, were sometimes responsible for restrictions on access to systems or data.
- Difficulties involving the fear of using computers, finding computers intrusive during consultations, and potential cultural insensitivity surrounding the use of computers in certain situations were noted.
- Support for new projects by the prospective user groups, including senior level change agents or project champions, and full consultation and inclusion of staff from the early stages of systems development projects, were thought to be helpful in minimising negative effects of fast paced organisational changes.
- Resources needed to be available to provide staff with support in training for, and the implementation of, new systems.

6.4.4.3 Summary of question area 4: Barriers

Many barriers to the improved use of computer systems for CDS were identified, although some beneficial changes had been made in the organisations studied. PHO resources had been made available towards a number of practice IS improvements, including funds for access to secure electronic communications systems and data mining software, thereby reducing barriers to systems integration, increasing data sharing and also eCDS. Additional resources appeared to be needed to address a variety of other issues and encourage the adoption of new systems to equalise practice IS infrastructure and performance, which would also increase eCDS. There was also a need for practices to all function with a high level of security protection. Organisational and training issues were sometimes responsible for restrictions of access to systems or data. Some of both PHO-MS staff and practice personnel needed additional training in software and systems use, better support from PMS vendors, more IS knowledge, and time for computer related tasks, for example, for information gathering. On-going support throughout the PHOs, including personal contact with a support person or in-house IT specialist was required, particularly with new systems and in reducing the range of barriers to the better use of existing ones. New projects needed support from all stakeholders from their inception, with funding also allocated to systems maintenance and support. Access to good quality data was needed throughout the organisations, with a reduction of information overload particularly at practice level, and assurances were needed for practitioners to feel confident that patient privacy was protected despite increased information sharing.

6.4.5 Question area 5: Ideal systems

What would your ideal system be like?

6.4.5.1 Background of question area 5

Health professionals/managers of PHOs need access to information to help them make decisions about their patient populations. The use of computerised information systems is seen as a way to assist in this area.

The last question of this interview was designed to determine what IS would help in addressing issues of CDS within the organisation. It provides an opportunity for PHO managers and members to express their opinions about what would help them in their work. This part of the interview provides answers to the question **'Can /how can IS support for CDM within PHO's be improved?'**

6.4.5.2 Ideal systems for improved eCDS

PHO 1 (pilot case) - Ideal systems:

Prospective improvements for CDS

A PHO-MS senior manager, Evan, said that the PHO should become more specific in terms of minimum standards and provide more support to achieve them. He felt that there was a need for a general practice leader, or a change agent who would help to drive improvements by "flying the flag". He thought better use of IS in CDS would be enhanced by enabling providers to see the value of their efforts, which was not currently the case. Another senior manager felt that better communications between all relevant service providers were needed, together with a database of consumer complaints and trends. This would ensure continuity of care and reduction of duplication. She also felt that improved systems dealing with funding were needed:

> …the PHO's going to have to be sure of the information that it actually uses through these different agencies - is reliable. Otherwise the whole feeling out there from people will be that this strategy isn't working, and…you know, 'it's just yet another way of getting money from us', and the PHO will take the flak through no fault of its own, really, because of information systems, and to me they are poor at the moment. (Senior manager, Linda)

She felt there was a need for improvements to be made to patients' awareness of the use of their information, and where to go for the information they needed to collect themselves. This would facilitate individual and community awareness, empowerment and responsibility for the health of the population, core objectives of the PHO. In terms of targeting appropriate populations for projects, she saw reliance on the deprivation index as being problematical, as vagaries in the data could result in some appropriate people being missed. She thought that the use of a range of communication channels would result in more people being reached to access services matching their needs, including those not currently engaged with health services. Regarding information systems, she felt there was a need to have all PHO members operating at the same level:

> …there's no communication system yet with the contracted providers… …It's all paper based…one of the GP practice doesn't have e-mail, one doesn't have a fax., so… …That's my key priority, actually, is getting them up to scratch, getting everyone onto the same level playing fields really. (Senior manager, Linda)

Simple measures were likely to soon be implemented to provide electronic versions of the PHO guidelines, stated a pharmacist facilitator. He also felt that the inclusion of a greater range of provider groups within the PHO, enabling more clinical projects, would be an important enhancer for future services as:

> …there is a huge potential and huge risk that anything that the PHO wants to achieve could be scuttled because there is only one provider involved. (Pharmacist facilitator, Barry)

Another improvement for the future would be the implementation of a website with secure access for GPs. This was discussed by the IT manager, Nadia, who lamented that it had been slow to be arranged due to lack of human resources.

A screening co-ordinator, Karen, felt that the predominant PMS in the organisation lacked some functionality regarding queries, when compared to another used in a different PHO. She also felt there needed to be standards for project data across practices, and that data collection for the new Performance Management Programme should be rationalised. She cited the cervical screening programme as an example, stating that practices would be required to respond to data collected from a national screening register instead of GP data, which could prove to be problematical.

Ideal System

In terms of ideal systems, the IT manager was in agreement with a senior manager, Linda, in stating the need for improved communications, including a simple contact list, and expressed the desire for a bigger IT department, such as was the case in some larger PHOs, although she cautioned that it was important to maintain a balanced view to the use of IT:

> …you can do just about anything with IT, to be quite honest, if you are willing to throw enough time and money at it. You then have to weigh up how much is it going to cost me to keep this alive, to keep it active, what are the chances for it to go wrong, and the more complicated you get, the more chances you have for it to go wrong, which means that you spend more time fixing it. To my mind you waste an awful lot of money. I really am a believer in keeping it simple, even with IT. (IT manager, Nadia)

Several other PHO-MS interviewees wished for simple improvements, such as a population health manager, Gwen, who wanted a laptop with remote access, and a community nurse, Kelly, who said that her workload would be decreased if, when working out in the community, she could enter information directly into her PMS, and would also find it useful to be able to provide patients with printed information she might not already have in hard copy. Access to patient information via the Internet, was also desired by a practice nurse, Tracey, who felt that Internet access would also be advantageous for her own education. A doctor at the same practice, Brian, explained that his ideal system would be one where patient information being imported into his PMS would automatically populate the correct fields.

PHO 2 - Ideal systems:

Perceptions of CDS

The definition of Clinical Decision Support as *"Access to knowledge stored electronically to aid patients, carers, and service providers in making decisions on health care"* (National Electronic Decision Support Taskforce, 2003, p. 20), was agreed with by a PHO manager, Leanne, who added that evaluation and research were important to ensure that management is efficient and effective. A clinical manager, Wendy, felt that CDS for her was provided through the Internet and her relationships with different organisations. From a doctor's point of view, Ian commented that PMS software made clinical information easier to access, which made decision making easier. Another doctor, Ross, limited by having restricted Internet connection, was also positive about his PMS software providing CDS through being able to access patients' clinical notes, problem lists, and medication records, but said he had limited support from other sources.

Prospective improvements for CDS

Improvements to systems in government departments would enable the PHO to receive valid and accurate data according to a senior manager, Stephanie, who also stated the need for access to population data. She explained her plans to implement a programme for practices which would include orienting new staff to be competent with the PMS. Better communication was also important for the PHO-MS and a new website was being developed to facilitate this. PHO manager Leanne, said the vision of the PHO was to move towards “interdisciplinary, intersectorial and multidisciplinary teams”, and had a vision for IT where there was an integrated database capturing data including all patient information, and improved communications with secondary care were also important. She felt the introduction of a smart form technology would provide some of that functionality when it was eventually fully implemented. From her perspective, outcomes from better CDS would be “…full evaluation and review and increased service provision in line with the PHOs vision.”

IT manager Ethan, spoke of his need to provide a cost effective secure messaging system for their rural GPs, and how the introduction of smart forms and the website would support clinical decision making in the organisation, explaining that the former would lead to more efficient population data collection and the ability to compare one practice to another. He respected the need for data collected to be anonymised, and explained that comparison of practices by management and by the GPs themselves should be coded for privacy. Support for clinical decisions could potentially be enhanced by promoting the use of a new cardio-vascular CDS programme.

A pharmacist facilitator, Helen, explained how clinical governance at the PHO could support such a move from either a philosophical or financial perspective. She had seen, and liked, a system developed by another organisation which streamlined data analysis of large files of data from the Pharm. and Lab. warehouses. Wendy, a clinical manager, emphasised the importance of training, and access to appropriate systems such as the Internet, for the GPs. Blair, a GP, added that good communications and more integration within the PHO would be welcomed. He felt that it would be advantageous if patients’ notes could be electronically accessed by, for example diabetes educators, working with his patients at other locations. Another doctor, Ian, was interested in having increased prompts in the form of smart forms, algorithms etc., had recently had a smart form technology installed, and was looking forward to its use being developed in the organisation. He thought that more resources for education would be helpful, and would like risk assessors integrated with the PMS although he considered some were very expensive and would have to be paid for by the PHO, which was currently considering some of the available software.

Ideal System

Stephanie, a senior manager, expressed the opinion that the PHO-MS already had an ideal IT set-up as solutions were always delivered, whereas the pharmacist facilitator, Helen, desired free and unlimited access to medical libraries, to be better connected to practices, and to continue to enjoy her broadband Internet connection. A clinical manager, Wendy, named a particular patient health status interface as a system she would like to use. She also thought a good system of disease information would contribute to better planning for patient populations. The adoption and current updating of data mining software in the organisation, enabling the capture of information from smart forms, was anticipated as a method of centralising data.

On the theme of centralised data, a rural practitioner, Blair, said his ideal system would make patients' results accessible by outpatients clinics e.g. diabetic educators, perhaps via a central system. His ideal system would also provide him automatically with hospital accident and emergency department (A and E) results, allow him to send electronic referrals to specialists by a secure messaging service (he trusted fax. and the postman, but not email), be able to import patients notes with them integrating completely with the PMS fields, and experience more communication within the PHO, for example with an electronic notice board, and a list of email addresses. The administrator, Becky, at the same practice said she would like to send reports electronically to the PHO-MS, and the practice nurse reiterated the doctor's comment that an ideal system would give her easy access to peoples' email addresses, for example other practice nurses in her own, and the neighbouring PHO, both seemingly simple requirements. She would also like to be able to refer patients to other providers with electronic forms, and thought the PHO-MS should be able to put their own reports together. Special Authorities should be available electronically, and she thought the PHO should have a training scheme for administrators as they have for practice nurses. From the doctors' perspectives, she felt that impediments included the paper mountain, computerisation, and bureaucracy in general, which were all increasing and needed to be reduced.

Another doctor, Ian, hoped for increased decision support, better system security measures, a fast system, and uninterrupted use of the computer, for example, when new software was being introduced, as embarrassing breakdowns had previously, occasionally, occurred at such times. A third doctor interviewed, Ross, wished for a secure system with Internet access, and his practice administrator, Nichola, also wanted Internet access, and to be able to do electronic claiming. On the subject of centralised systems, the doctor had divided opinions but was mostly sceptical, although he felt that they would arise eventually. He thought that centralised systems might provide hackers with more value for accessing the data of, for example, forty or fifty thousand patient records. Although there was still the potential for information to be stolen from practice computers, he felt that the current situation in New Zealand, with most practices having largely stand alone systems, would probably be of fairly low risk. He discussed his divided opinions, and his concerns for the confidentiality and privacy of patient information, regarding centralised systems:

> Of course there is greater potential for information sharing, where that is deemed to be important, but, yeah, I do still have a lot of concerns about the ability to keep information, patient information, confidential in that setting, and I don't - it would be interesting to canvas the public on what they thought of that idea as well… …I'm also of the belief that, under the present system, that the information that we hold in our files is our information, if you like, ours and the patients. It's not the PHOs, and I don't know that we want to be giving away all the rights to that information so easily. I think if we go to a system where there's a centralised data source, we're gonna lose all control over who has access to that information, and for what purpose. This is my paranoia coming out. (GP, Ross)

PHO 3 - Ideal systems:

Perceptions of CDS

One of the GPs, Tim felt CDS:

> …needs to be evidence based, practical, pragmatic summaries or reviews on management of medical conditions… (GP, Tim)

He also commented that useful support could be provided through diagnostic verification, and PMS features such as knowledge resources, and pharmacy support, although he regarded his PMS pharmacy support tool as "…next to useless…" as it was too sensitive, and he was only interested in being alerted to relevant interactions. This was seen as a problem as the information was often ignored. He was positive about his broadband connection and 'Googled' information on favourite sites. Other views were held by a solo practitioner, Robert, who found no use for a computer in his consultations, finding it time consuming. He preferred to draw his CDS from books and paper based guidelines and algorithms, and only occasionally searched the Internet for medical information when at home. A third GP in the same PHO described what CDS meant to him. He received letters from specialists and the hospital electronically, including x-ray and lab. results. These were received by email, or via a secure messaging service directly into the PMS. He also appreciated using the Internet, including within consultations, commenting that it was amazing how quickly one could get to reliable places for obscure things. He described a paradox whereby rare conditions can actually be seen quite commonly in primary care, and by using the Intenet one could normally find a reliable university site somewhere that would provide useful information. He also appreciated the support provided by his PMS, but could see room for further improvements:

> …to me we don't have what I would consider true clinical decision support where you actually enter data and it guides you along the path as well…what I use, is…templates where I would tick all the boxes to make sure I've asked all the right questions, so that's sort of putting a structure into your consultation and a safety thing… …there are some little calculator type features within [the PMS], which you can use to very quickly work out such thing as creatinine clearance…They're sort of simple tools. To a degree, the structure of the notes gives you some clinical decision support in that you can see the information easily and quickly…as opposed to paper notes …and you can do such things as graph results and see trends happening. It's often visual - much easier visually than looking at the raw numbers, so those are things I get out of the PMS system itself. (GP, Stewart)

At the same practice a nurse, Sylvia, reflected on the positive and negative effects of computer systems on her work. She felt that computers made more work possible which had increased workloads on one hand, but in other ways had saved time, and stated she would not want to be without one in her work.

Prospective improvements for CDS

The need for a regional approach to the implementation of CDS tools, was considered essential by a senior manager, Carol, who had sought to establish what support would be available from the DHB. She also spoke of recent incentives the PHO-MS had put in place, such as offering to pay for a secure commercial VPN service and a smart form technology for a year for the practices, and suggested they would probably continue to finance the latter because it provided a distinct advantage to the PHO-MS. A pharmacist facilitator, Chris, was impressed by a CDS system he had recently seen demonstrated, and others spoke of the forthcoming involvement of the PHO in a pilot trial of another such system. IT manager Garry, felt that it would be very beneficial regarding technology, if the practices were to amalgamate as a group. His efforts to provide a cost effective and secure centralised system had been thwarted by one of a group of three potential vendors, due to complex licensing laws, which prevented the PHO being eligible for a cost effective solution. He stated strongly that GPs and practice staff should be consulted more regarding IT and workload issues, and felt that increased demands associated with technology were a great problem. A service manager commented that the PHO would be doing a lot of data collection through the integration of smart forms with practice PMSs, but pointed out that not all practices were on the predominant system which supported that approach. However, she stated her vision as follows:

> My passion is to make…pro-active health care, and time efficient tools…to allow practice teams to deliver effectively and efficiently. (Service manager, Sally)

One of the GPs, Stewart, was positive about centralised computer systems, provided adequate privacy safeguards were present. He thought back-up could potentially be more frequent, but thought some of his colleagues would be resistant to the concept of centrally held data. He considered that better integration with secondary care was needed and commented that joint development would be necessary as primary care systems were more advanced. Finally, another doctor, Robert, commented on the issue of patients accessing the Internet for medical information, commenting that he was quite happy for them to do that and then discuss their findings with him during their consultation.

Ideal System

When asked how else did she think the PHO could support clinical decision making in the organisation, and what would her ideal system be like a senior manager, Carol, replied:

> That's really facilitating of an agreed CDS across the region. All from the same song sheet……'Ideal system'? Well, certainly for CDS it is up to date, relevant and easy to access - responsive…evidence based, and, you know, easy to navigate…that a kid could do it… . (Senior manager, Carol)

From the PHOs point of view, she said they wanted to be able to replace manual processes by collecting clinical data automatically from practice PMS systems without bothering the practice staff, and said that smart form technology would contribute to that. A pharmacist facilitator, Chris, wanted a more responsive system for quick feedback, providing up-to-date external data, for example, from the Pharm. and Lab. warehouses, so that he could detect developing trends, and the PHO service manager, Sally, thought the relationship between the PHO-MS and practices needed to be trusting, so that PHO-MS could "pull" data and give feedback more readily. She thought it would be preferable to have one vendor's PMS in the PHO, or all PMSs "talking the same language" to enable generic tools to be built, and that PMS vendors should be more responsive to requests in this respect. Web-based ‘Doctor Global like’ systems with multi layered access rights to information by practice team, patient and specialist, with patient consent, had impressed her and she also thought the ability to produce electronic prescriptions was desirable. She had divided opinions on the subject of a central data repository. A doctor at a busy urban practice, Tim, thought a palm pilot integrated with the PMS would be very useful, and on the larger issue of a centralised system, was fairly positive, provided financial information was separated from the patient management information. His ideal system would be a PMS centralised at the PHO level, where the management handled changes such as updates and government changes to schedules, but it would still be flexible for the practice environment. The PHO management would extract the data they needed, under agreed criteria on how the data was to be extracted, such as, for example, the approval of a committee deciding which data is being utilised and for what purpose. The extraction process could then be done by PHO management, rather than the physical requirement for that data to be produced by the practices. This would result in a more sophisticated system, with clinical decision support provided centrally. The doctor commented:

> …it may come out - partly out of your own budget, but I would imagine that you could begin - get economies of scale. That would be the advantages that I’d see, whereas the way it works now is each practice re-invents the wheel virtually… …[there’d be a] better bang for your buck. (GP, Tim)

The practice administrator, Diane, at his surgery thought Internet access for nursing staff was desirable and it was pointed out that staff had to share computers at times as not all computers had the same software. At another practice the doctor, Robert, and his practice nurse, Carrie, were both negative about systems being centralised at the PHO level, with the doctor stating that he did not want the PHO to have access to patients’ notes. However he would appreciate receiving electronic lab. results, while, Carrie, wanted their PMS vendor to visit and improve, at no cost, some small annoying problems with their system, and to have an accounting software package to help with practice finances. The remaining doctor interviewed at PHO 3, would appreciate a DSS such as one which was soon to be piloted in the PHO, although his practice administrator, Zoe, was satisfied with their current system. He noted that the DSS incorporated a change management package, which he thought was very important in helping users to adopt the new system. He also favoured the idea of a seamless auditing system, with safeguards on the type of data accessed allowing only anonymous data to be collected, and was looking forward to having the patient health status interface, which was soon to come. The doctor elaborated on how he had been impressed with a new DSS he had recently seen demonstrated at a GP conference. He described how it could provide a diagnosis, or a probable diagnosis, and would, if the clinician agreed with the decision support, provide a recommendation, such as to follow ACC guidelines, refer on to a physiotherapist, or make an urgent referral to a specialist. It could then provide further support by, for example, printing an x-ray form, and interacting with the local hospital, taking one automatically through to the booking office, whereby the patient could be given their appointment immediately. He enthused further:

> …its great advantage is, unlike the early decision support things…which had focused on a single disease, this is wide. It has dermatology things in there, and it has cardio-vascular disease, it has diabetes, it has…the accident parts, and things like that, and it has patient information attached, so it reminds you if, for example, if someone came in with a knee injury and it tells you to do a Lockman test, and you've forgotten…you just hover over where it says 'Lockman test' and it'll come up with a little video of how to do [it]. (GP, Stewart)

He explained that such a system would be purchased for a locality rather than a practice, and would therefore be customised for a particular DHB or PHO area. However, the final decision as to whether or not the system's recommendations are accepted would lie with the practitioner. He was happy with this proposition, and the prospect of a record of any decision over-rides being stored. The doctor went on to describe how it could soon to be integrated with a second main PMS system, and that it interfaced with patient notes so that any changes were updated on each system without the need to double handle data. He mentioned how one DHB had already purchased the system, and that a similar system was being used by another, commenting on the fast pace of change and the number of developers. He concluded by saying that "It would be lovely" to have such a system.

Cross case analysis - Ideal systems:

The need for practices to all be functioning at a similar level with IT was important to management in all three PHOs, and recent changes to software were evident in all cases, with many management and practice staff looking forward to resulting increased eCDS. Resource support, including finance and training, from the PHO-MS organisations appeared to be crucial for the adoption of many of these technologies. Several doctors said their ideal PMSs would support the importation of patients' notes, with the appropriate fields being automatically populated. Other individuals had simpler needs, wishing for lap-top computers, Internet connections, or remote access to their base systems. Each PHO-MS had attempted to influence all their practices to adopt common PMS systems, and had invested in data mining software, while PHOs 2 and 3 were introducing smart forms, and PHO 3 was newly funding a secure commercial VPN service and a patient health status interface, and was about to take place in the piloting of a new DSS. Enthusiasm was expressed by PHO 3 PHO-MS and doctors for new DSSs being developed.

PHO 2 administrators commented that, to them, CDS was enhanced by research, evaluation, and relationships with different organisations, and doctors in PHOs 2 and 3 appreciated their PMS systems for providing CDS. However, two doctors interviewed, in the pilot study and PHO 3, still favoured support from paper based sources of information during their consultations. Improved communications, including such simple measures as contact lists, were cited as important for CDS in the future, mostly by PHO-MS staff in PHOs 1 and 2 and practice staff in PHO 2. A senior manager of the newly formed PHO 1 mentioned that a GP change agent would be helpful in encouraging others to make improvements in their practices. Several PHO managers commented on aspects relating to the need for improvements to some health service systems. Many PHO-MS staff expressed the desire for better quality, or more timely data, and the centralisation of systems was favourably mentioned several times, with acknowledgements that privacy issues would need to be solved. The collection of data through smart forms and data mining software was seen as a useful move in this direction. The opinions of doctors on the subject of centralised systems were varied, with some being quite positive provided patient privacy, and in one case, the privacy of practice financial data, was maintained. However, others felt that patient data needed to be retained at the practice rather than PHO-MS level. This question was not part of the questionnaire survey and therefore no quantitative data on it is available.

'CDS improvements/ideal systems' findings

Various suggestions for the improved use of computers in CDS within the PHO environment were discussed during the interviews, and findings on individuals' preferences for their ideal systems are listed below:

- CDS "…needs to be evidence based, practical, pragmatic summaries or reviews on management of medical conditions…" (GP, Tim)
- The provision of better quality, and more timely data were required through improvements to health service systems.
- CDS within the PHO environment were thought to potentially be enhanced by research, evaluation, and relationships with other organisations.

- It was considered that practices should all be functioning at a similar level with IT, and with the use of a common PMS system.
- It was suggested that GP change agents would be helpful in encouraging others to make improvements to IS in their practices.
- Some GPs wanted their PMSs to be able to support the automatic population of fields when importing patients' notes.
- Paper based sources of information available during consultations were still favoured by some.
- Improved communications were thought to be important for CDS in the future.
- Contact lists were needed.
- Lap-top computers, Internet connections, and remote access to base systems, were often not available to field workers.
- Many, of both management and practice staff, were looking forward to increased CDS resulting from recently introduced software, and were positive about new DSS being developed.
- Resource support, including finance and training, from the PHO-MS organisations appeared to be needed for the adoption of many newly introduced technologies.
- Any plans for the centralisation of systems were thought to need full discussion with stakeholders, particularly with respect to privacy issues, with such consultation being also applied to newly installed data collection/mining software.
- Doctors held varying opinions on the subject of centralised systems, with some being quite positive provided privacy was maintained, particularly of patient information.
- Many doctors felt that patient data needed to be retained at the practice rather than PHO-MS level.

6.4.5.3 Summary of question area 5: Ideal systems

Improved communications were considered important for enhancing CDS, and up-to date information on useful contacts was lacking. Health service systems needed to provide better quality, and more timely data, and improvements were being addressed. There was a need for the integration of systems between different functional groups to be improved, for example by equipping community, or off-site workers with lap-top computers, Internet connections, and remote access where none were used. Information sharing throughout the PHO would be enhanced by systems being well integrated and equal, particularly in member practices. Paper based sources of information were still favoured by some, and GP change agents were thought to be potentially helpful in encouraging the use of new IS. Additionally increased resource support from the PHO-MS organisations, including finance and training, was considered necessary and an enhancement for the adoption of many newly introduced technologies. Many management and practice staff, were looking forward to increased CDS resulting from recently introduced software, and were positive about new developments in DSS, and several doctors were looking forward to PMSs which would support the automatic population of fields when importing patients' notes. The resolution of issues regarding the privacy of patient data was signalled as an important factor in any plans for the centralisation of systems. Full discussion with all stakeholders would be necessary, and should also apply to the implementation of any information sharing technologies such as the newly installed data collection/mining software. Doctors' opinions varied on the subject of centralised systems, with some being quite positive provided patient privacy was maintained. Many doctors felt that patient data needed to be retained at the practice rather than PHO-MS level.

6.5 Summary of the data analysis

This section concludes the data analysis chapter and 'theory testing', the third of Bourner's research process steps (in Greenfield, 1996). The pilot study analysis contributed substance to the theoretical framework applied in the research. This, together with other pilot study findings helped to provide a foundation upon which the use of eCDS in primary health care could be studied. By applying the fully developed IT sophistication survey questionnaire at the practice level, two groups of PHO practices were compared and the tool's potential use as a benchmarking method was demonstrated. Qualitative research provided rich information, which together with the quantitative findings, has illustrated the current environment of eCDS in New Zealand PHOs. Both PHO-MS and practice personnel are striving to provide health care services in a fast evolving information environment. PHO-MS staff are facing challenges with, for example, obtaining good quality data from government organisations and their member practices, whilst the latter must provide appropriate data in addition to conducting their usual professional functions and with limited resources. Within individual PHOs, practices exhibit a range of IS utilisation despite being well equipped. A model of eCDS utilisation in PHOs and five areas important for its improvement emerged through the process of qualitative data analysis and are presented in Sections 7.4 and 8.3 respectively. These were developed through data comparison and the identification of themes which cut across the question areas. The next chapter provides a discussion of the findings reported in this chapter together with the model description.

7 Discussion

7.1 Introduction to the discussion

This chapter, together with Chapter 8, corresponds to Bourner's fourth and final research step named 'Reflection and Integration' (Bourner, 1996). The final research step seeks to address such issues as how the research findings relate to current thinking, and how they fit into the field of knowledge (ibid., p. 10). The introduction to the discussion chapter is followed by four main sections addressing firstly the IT sophistication framework and its application in the PHO environment. By exploring the IT sophistication of the organisations studied, information on their activities/processes, types of technologies and their usage, and systems integration is determined. This forms a foundation for further studies of the use of IS in the support of CDM, which is the focus of section 7.3. Knowledge of how IS can be utilised for improved CDS, which is provided by this study, will be of value to a range of health professionals, managers and researchers. The discussion of the use of eCDS in the case study organisations is presented with reference to the research question areas. A number of recurring themes are seen to be evident across the range of question and five key areas of importance for eCDS utilisation in PHOs are identified. A conceptual model of eCDS utilisation by GP practices, developed from the research, is presented and discussed in section 7.4, followed by a discussion of research quality and, lastly, a summary of the chapter.

7.2 IT sophistication in primary care organisations

The framework and survey tool based on the concept of IT sophistication is important as it enables a thorough study of organisational IS, and comparisons within and between organisations. Where sufficient survey responses are gathered, statistical analysis can test various relationships with IT sophistication levels in different domains. For example, relationships between IT sophistication and financial and clinical outcomes can be determined, or causative influences on IT sophistication levels observed. Such information can be used to direct funding into areas which will support organisational strategies. It would therefore be useful for New Zealand primary health care managers to be able to compare groups of provider practices, or groups of PHOs by applying the approach presented in this thesis. Through the use of a survey tool developed during this study specifically for use with the target GP practices, comparisons between two groups of practices have been made, based on knowledge of the range of possibilities. Due to the limited number of practice respondents, analysis in this research was limited to descriptive statistics. It was observed that practices of both PHOs surveyed were well equipped with a range of technologies and conducted a wide range of computerised activities. However, there was a limited use of remote patient monitoring devices and recently developed CDSS, and no evidence of the use of telemedicine. They had generally high levels of internal systems integration, but with more limited integration of systems with some remote workers, their PHO-MS, other practices, and other external entities. The usage of available technologies was widely variable in both groups of practices. Therefore, the results suggest that future development efforts will need to include the implementation of new technologies, improvements to some areas of systems integration and increased utilisation of systems by some users.

The fast developing nature of IS delivers challenges to end-users and the organisations they work for. When this is coupled with changes in the structure of organisations and the functions of certain domains within them the challenges are great. Primary health care is undergoing a range of changes with increasing integration of IS and information sharing throughout the health system. More emphasis is being placed on providing patient care at the primary level, and practices are beginning to evolve into larger multidisciplinary centres with additional home based care options and a greater need for well integrated IS. Patients will increasingly be empowered with mobile systems to monitor their conditions and assist in their treatment. Therefore, systems that are compatible throughout an organisation, well integrated and with good user support will be beneficial to providers and patients alike. Additionally, with the extension of PHOs to encompass pharmacists, radiologists and other service providers, more complexity will be introduced with an even greater need for systems compatibility. As a wider range of providers are included, the need for training and on-going support is likely to grow as some will need to adapt to working with increased and more complex IS resources while others adapt to newly integrated systems. Where possible, systems which are compatible, have a similar range of functions, and are uniformly extendable and user friendly need to be developed, whilst at the same time allowing for individual preference in their selection and the avoidance of the development of vendor monopolies. A coordinated development approach, supported by a comprehensive knowledge of the IT sophistication in the sector, is most likely to produce appropriate and potentially future proofed systems.

7.2.1 Support for the use of the adapted IT sophistication framework in primary care

Various approaches and tools for the assessment of IT use in health care have been reported (ACNielsen, 1998; Culler et al, 2006; Didham et al., 2004; Engelbrecht et al., 2004a, 2004b; Grant et al., 2006; Henderson et al., 2006; Western et al., 2001; Western et al, 2003). Examples of these approaches which have influenced the current research will now be discussed in the light of the study findings. A 1998 report prepared for the General Practice Branch of the Department of Health and Family Services (ACNielsen, 1998) on the levels of, and attitude to, IT in general practice in Australia, found that research in the area at that time was limited, with sometimes biased methodologies and terminology which was hard to interpret. They felt the term computerisation needed to be clarified and discussed the need to differentiate between its use for administrative and/or clinical purposes, identify the task divisions in the practices, and determine the patterns of computer usage within multiple practitioner practice environments (ibid.). The need for further research in the area of primary care computing was evident and the current study has addressed some of these issues and more, such as by differentiating between the amount of use of IS for activities in the administrative, and patient management and care domains, and their integration. Both quantitative and qualitative methods were used in the ACNielsen (1998) report which provided the basis for a further study of Australian general practice computerisation (Western et al., 2001; Western et al, 2003). Later, computer usage patterns in Australian general practice were benchmarked using interviews and telephone surveys (Western et al., 2001; Western et al., 2003). The authors divided computerised primary care functions into three task groups: Clinical; patient oriented administrative; and general administrative. Despite their potential for improving clinical outcomes for patients generally, functions such as the use of computerised CDS systems were found to be used less than other computerised functions (Western et al., 2001; Western et al., 2003). The current study also found that eCDS was underutilised in many GP practices. Additionally it addressed the state of integration of systems, identifying that although systems were integrated well in most practices, improvements were needed for integration between the practices, community workers, and their PHO-MSs.

Also in Australia, a 2006 paper reported that 6% of GPs did not have a computer at their practice, with 5.2% of GPs not using a computer at work where one was present, and where clinical software was available 6.6% of doctors did not use it (Henderson et al., 2006). Most GPs who did use a computer at work used it for electronic prescribing, test ordering, and recording certain patient information, but only a third recorded all patient information in an EMR (ibid.). Of the GPs surveyed, 21.7% were keeping all data in electronic format and utilising all available clinical functions (ibid.). Didham et al. (2004), found a high level of IT amongst New Zealand primary care practices, with 99.8% having at least one computer and 99.0% using a PMS, but the current study found evidence of underutilization of available systems, particularly with respect to eCDS. Therefore, this research has contributed to the current understanding of primary care computing by extending the knowledge of how technologies are used in PHOs, with a focus on their use for eCDS.

Canadian and US researchers have also used postal surveys to determine and compare IT sophistication in groups of secondary care facilities (Culler et al, 2006; Jaana et al., 2005; Paré and Sicotte, 2001). The framework used in Paré and Sicotte's (2001) approach included the important dimension of systems integration, and was adapted to the study of technology use in New Zealand primary care in the current research. The approach had been developed and applied in secondary care in Canada and the US, but had not been used in New Zealand or adapted for use in primary care until this study. The current study goes beyond current work in New Zealand primary care in its potential for use as a benchmarking tool, and the foundation it provides for the study of eCDS. Providing a benchmark by which organisations can compare themselves to other similar ones can provide research which is of practical relevance to managers (Benbasat and Zmud, 1999). In applying the framework to primary care and generating the survey tool, two main practice domains; administrative, and patient management and care, were considered in terms of three dimensions; their computerised activities/processes; the types and amount of usage of the IS used to support those activities/processes; and how well integrated the IS are. The domain of clinical support which is found in Paré and Sicotte's framework, provided by hospital x-ray, radiology and pharmacy departments, was not included in the adapted framework as applied in this study. These services were provided by entities external from the medium sized PHO organisations taking part in the research. However, this clinical support domain could potentially be included for larger PHOs, or where future developments result in the membership of such entities in the PHOs.

By studying the participating PHOs, using the IT sophistication framework, a knowledge base has been provided, forming a foundation for the exploration of eCDS use within the organisations. The results from the questionnaire sent to practices in the pilot study indicated that where most primary care practices were well equipped with

IS, with a high proportion of activities being computerised, individual practices exhibit a range in the amount of usage of their technologies and their utilisation for CDS.

The qualitative pilot study research also found that PHO management systems were well integrated within their offices, as were practice systems, but there was less integration between PHO management and their member practices, and little between member practices. Community workers also lacked integration with their base offices. Electronic integration within the PHOs, and with external health care entities, was provided by secure messaging services, email and fax., but the use of these technologies was variable. Data mining software was being introduced and was likely to increase integration through data collection from the practices. Findings from the studies of PHOs 2 and 3 confirmed these findings. Systems integration is likely to become increasingly important in primary care with evolution in the direction of multi-team practices.

The survey tool developed during this research was tested in the GP practices of PHOs 2 and 3 and found to be relevant for that purpose. Rigorous, iterative development provided a questionnaire with appropriate items, and responses contained little, if any, added information in sections provided for 'other' items. The survey tool has the potential to be used by medium sized New Zealand PHOs to determine the IT sophistication of their member practices, and enable practice staff to compare their practice infrastructure to that of other practices in their PHO. A similar survey tool designed for application at the PHO level could be used by DHB managers to determine IT sophistication amongst their PHOs, or MoH managers to compare groups of PHOs. Using such an approach, disparities in IT infrastructure, its use and its integration, could be identified, and measures taken to equalise the IT sophistication throughout primary health care organisations.

7.2.2 Quality measures and the survey tool

The framework supporting the development of the IT sophistication survey tool was adapted from published international research on health care IT. The final question items were provided by iterative development during the pilot study and final two case studies, using interviews and a pilot postal survey. Interview data analysed with respect to the framework provided PHO-MS level information on IT sophistication in the organisations. In order to include as many opinions as possible for each PHO, a range of PHO-MS staff, and where possible a doctor, a nurse, and an administrator for each practice, were interviewed. GP practices included ones covering the ranges of IT capability in the organisations. The thorough development process ensured validity of the final survey tool for use in medium sized New Zealand PHO GP practices, and the generalisability of the results to such organisations. Reliability of the study was demonstrated through the use of a detailed research plan documented in Chapters 4 and 5, together with the semi-structured interview schedule and questionnaire, which could be used by other researchers to facilitate replication of the research findings. The research plan could also be followed as a method for determining the IT sophistication at the PHO level using a similar framework and single survey tool, and developed in the same way.

Results generated by applying the IT sophistication framework and resulting survey tool in the participating PHOs, provided a foundation for an in depth study of the use of IS in the support of CDM within the organisations. This part of the study is the subject of the following section.

7.3 eCDS in primary care organisations

The study of eCDS undertaken in this research was explored through five main question areas. The research questions were answered through interviews with PHO-MS and GP practice staff, and a postal survey of GP practices, and the data analysis was presented in Chapter 6. A discussion of the results is presented in this section and follows a question and answer format in alignment with that used for the analysis. The main question areas include sub-sections where appropriate and are as follows: 1. Computerised CDS; 2. Information processing requirements; 3. Impacts of PHO establishment; 4. Barriers; and 5. Ideal systems.

7.3.1 Question area 1: Computerised CDS

"In caring for your patients/patient populations, what types of computer support do you use in your decision making?"

Responses to this part of the interview schedule contributed answers to the research question **'How do PHO health professionals/managers use IS for clinical decision support?'**

7.3.1.1 The use of popular systems:

Practice Management Systems, e-mail, the Internet, and stand alone Decision Support Systems can provide support in primary health care (Bannink et al., 2006; Engelbrecht et al., 2004a, 2004b; Grant et al., 2006; Riddell et al., 2007 ; Wells et al., 2007; Whittaker et al., 2006). A study by Grant et al. (2006), of US physicians' use of IT with respect to e-mail, CDS during consultations, and on-line activities, suggested that although the technologies studied were relatively easy to acquire, they were only being used by a minority of physicians to support clinical care. The current study of health professionals and managers working in New Zealand PHOs determined amongst other findings that three popular technologies are being used for a range of activities, including CDS in its wide sense, by individuals in differing roles within the organisations, and highlights areas where the use of available technologies for CDS can be improved. The following systems are now discussed:

1. Practice Management Systems,
2. email
3. the Internet

The use of PMSs, the Internet and e-mail, for providing CDS was evident in the study. Both PHO-MS and practice staff found value in using them for this purpose. However, practice use of the technologies was found to be variable in PHOs 2 and 3, as was observed in the pilot study (Engelbrecht et al., 2006, 2007a, 2007b), signalling the possibility of increasing eCDS use within a group of practices by supporting under users.

Interviewees from both PHO-MSs and practices were enthusiastic about their PMS systems and most, but not all, GPs kept patients' notes electronically. The potential for these technologies to be increasingly used for CDS would be in enabling all practitioners to fully use their PMS by reducing limiting factors. A lack of typing skills was signalled as one reason contributing to limited PMS use, a problem which is likely to reduce with time. Those practices using a PMS which was not predominant in the organisation would benefit from more support with, for example, querying the database. There may be a number of reasons why they are retaining the use of their current system, despite encouragement from their PHO-MS to align with the majority of practices. For example, the practice owner might perceive disadvantages in changing to a new system through the potential loss of valued staff who are fearful of a system change. The need for faster responses to user requirements by systems' vendors would also be welcomed.

Email was also capable of delivering information useful in CDS, for both management and practices, with appreciation expressed for its ability to allow fast communication. However, there was a need for more practices to be email capable, especially in the pilot PHO, and not all staff were connected within some practices. The lack of provision of useful e-mail address lists was regretted by members of both PHO-MS and practice staff, and would be a relatively simple improvement. Information overload, and spam were other problems highlighted as reducing better practice utilisation of such systems, and could be partly reduced through improvements to systems security.

The Internet was a popular source of information for CDS by most people interviewed, and many had favourite web sites providing useful high quality medical information. A few people regretted not being able to take advantage of it due to a lack of access, for example, whilst working off site. Not all individuals in an organisation had a connection, and some found it too time consuming to use it while at work. The latter problem sometimes resulted in CDS information being sought on the Internet outside of working hours. However, others reported its usefulness even whilst in consultation with patients. Therefore improved access would be useful for some, whilst assistance with better search techniques might benefit others.

PHOs 2 and 3 indicated significant use of popular systems in CDS, despite a relatively low score from PHO 2 for the use of email in providing CDS. When considering data from individual practices within each PHO the results were very variable as was observed in the pilot study (Engelbrecht et al., 2006, 2007a, 2007b).

7.3.1.2 The use of CDS tools:

A number of computer based CDS tools have been identified and their use in the participating PHOs are now discussed. Gillies (2005) suggested that the adoption of currently available clinical tools would be facilitated by the tools being readily and rapidly available on demand, user friendly, reliable, relevant to individual patients and localities, current, and focused for specific user types, and described available tools as follows:

- Alerts and reminders, both for efficient time-management and also for recalls of patients for various procedures such as immunisations, etc. Alerts for prescribing are available aimed at reducing the risk of the patient being prescribed incompatible medications.
- Diagnostic tools to assist the clinician at the point of care both in developing an appropriate differential diagnosis, and also in refining the answer by recommending differentiating tests.
- Evidence-based health information in focused form that is readily available to the clinician at the point of patient contact.

- "Expert" opinions are available especially involving the transmission of data from organ imaging scanning technologies. (Gillies, 2005, para 3)

Coiera (2003), described alerts and reminders, diagnostic assistance, information retrieval, image recognition and interpretation, and also therapy critiquing and planning, and prescribing decision support systems, as examples illustrating the application of knowledge based systems, or expert systems, which he stated are the most frequently used CDSS used in clinical practice. The current research provides information on how such technologies described above, are currently utilised in the PHO environment and how their use might be facilitated further. The list of tools, based on Coiera (2003) and Gillies (2005), is as follows:

1. Alerts and reminders (e.g. allergies; drug interactions)
2. Prescribing decision support (e.g. MIMS)
3. Diagnostic assistance/assessment tools (e.g. risk calculators/ algorithms)
4. Focused evidence-based health information (e.g. Medline, Cochrane)
5. 'Expert' opinions/systems (e.g. image recognition and interpretation)
6. Therapy critiquing and planning (e.g. Clinical Guidelines)

All tools were found to be used to varying extents by management and practice staff of the PHOs, with the exception of Tool 5 'expert opinions/systems (e.g. image recognition and interpretation)', which was not considered relevant by those interviewed at PHO-MS. The postal survey found alerts and reminders, and prescription decision support tools to be most used, with the least used tools being expert opinions/systems, and focused evidence-based health information, by practices in PHOs 2 and 3 respectively. The three most used tools, including those for diagnostic support/risk assessment, are provided to a greater of lesser degree through most PMSs, and therefore any measures to improve PMS use would be likely to increase their use. The use of stand alone DSS, was not found to be widespread at the time of the study. However, changes were rapidly taking place and were likely to become more common in the near future. Prescription support provided through the PMS was mentioned by many as being too sensitive, to the extent that it was often disabled or ignored and would therefore benefit through further adjustment by developers. Other improvements signalled were through access to new stand alone risk assessment tools and CDSS which were of interest to interviewees from both management and practices. Questionnaire results were mostly lower for one of the PHO practice groups than the other, possibly indicating that the use of CDS tools in general is slightly less in that PHO, although there was strong agreement in the low use of ‘expert' opinions/systems. Systems providing properties relating to therapy critiquing and planning were being introduced into the practices of both PHOs, and were being positively received by several GPs interviewed, representing both PHOs. The systems appear to have the potential to considerably elevate available CDS by improving areas such as risk assessment, therapy planning and critiquing, as well as facilitating reporting, providing appropriate support is provided during and after their implementation.

Increased use of focused evidence-based health information, could be encouraged by enabling potential users to have better web searching techniques, with guidance on useful sites, and ensuring that their PMS is fully utilised. Several interviewees commented that they would like to access evidence bases more but, in addition to time constraints, did not know where to look, or had forgotten where they had seen something interesting due to infrequent use of the resource, or had been discouraged by membership and password access requirements. The use of expert opinions/systems, especially with reference to such as image recognition and interpretation will depend on good integration of systems with other providers such as those in secondary care.

7.3.1.3 The use of CDS features:

Published literature describes certain features of computerised CDS. From a systematic review of 70 randomised controlled trials, Kawamoto et al. (2005) identified four positive features as being critical success factors for using CDSS to improve clinical practice: “(a) decision support provided automatically as part of clinician workflow, (b) decision support delivered at the time and location of decision-making, (c) actionable recommendations provided, and (d) computer based.” (ibid.). Other features were described by Metzger and MacDonald (2002) who outlined that decision-support tools could assist physicians as follows:

- Bringing accessible information and knowledge to the point of clinical decision-making;
- Bringing knowledge relevant to the particular clinical situation (for example, the specific patient, the specific issue, or the specific medication) to the physician when needed;
- Combining clinical knowledge with patient information to help the physician stay abreast of the patient’s health status (for example, identifying preventative interventions that are due or issues requiring follow-up);
- Identifying patients lost to follow-up or overdue for recommended interventions, and

- Alerting the physician to contraindications or potential problems by checking planned actions against other patient information and generally accepted clinical knowledge. (ibid. p. 5)

Presented next is a discussion of how participating PHOs' systems fulfill the following CDS features from Kawamoto et al. (2005) and Metzger and MacDonald (2002):

1. Bring information and knowledge to the point of clinical decision making (decision support delivered at the time and location of decision making).
2. Provide decision support automatically as part of the workflow.
3. Provide knowledge relevant to the particular clinical situation (e.g. for a particular patient, issue or medication) when required.
4. Combine clinical knowledge with patient information to help you keep abreast of the patients health status (e.g. for prevention, intervention or follow-ups).
5. Identify patients lost to follow up or overdue for recommended interventions.
6. Alert you to contraindications or potential problems by checking planned actions against patient information and generally accepted clinical knowledge.
7. Provide actionable recommendations.

Two GPs were generally positive about the ability of their practice systems to provide the features discussed, although others were more skeptical. Where patients' notes were not stored electronically, a practices ability to exploit their systems capacity was limited, and one doctor felt that his system should provide more automatic functions, acknowledging that a soon to be introduced system would improve things. The questionnaire data placed 'Identify patients lost to follow up…', and 'Alert you to contraindications…' as the two highest rated features, with 'Provide actionable recommendations', and 'Bring information and knowledge to the point of clinical decision making…' as the lowest, for PHOs 2 and 3 respectively.

Practice staff in PHO 3 possibly had more CDS features available, or were more skilled in utilising existing ones but, given the small sample, the results could easily be subject to bias. Variations in experience of the features were felt to be related more to interviewees' work roles, rather than any vast differences between the cases. For example, a feature such as 'alert you to contraindications or potential problems…' would not be relevant to most PHO-MS managers, where it would be to GPs and practice nurses, although some of the other features were.

The interview and postal questionnaire data confirmed some level of appreciation of each CDS feature by various individuals in the cases studied. The most commonly found feature was ‘Identify patients lost to follow up or overdue for recommended interventions’, with ‘Alert you to contraindications or potential problems by checking planned actions against patient information and generally accepted clinical knowledge’ in second place. ‘Combine clinical knowledge with patient information to help you keep abreast of the patients health status’ was in third place, followed by ‘Provide knowledge relevant to the particular clinical situation (e.g. for a particular patient, issue or medication) when required’. However, results from the pilot case study revealed that a small proportion of individual practices surveyed reported that their systems did not provide three features at all, those being ‘Bring information to the point of clinical decision making’, ‘Provide decision support automatically as part of the workflow’, and ‘Provide actionable recommendations’, and that these features rated amongst the four lowest ranked features (Engelbrecht et al., 2006). When the final survey tool was applied in PHOs 2 and 3, the three features were also rated lowly. These three features, together with one other, that the systems should be computer based, were described by Kawamoto et al. (2005), as being the most important indicators of the ability of CDS systems to improve clinical practice. The authors of the review suggested that these features should therefore be present when possible in CDS systems (ibid.). Results from the current study, therefore, indicate that efforts should be directed at improving the use of these features.

7.3.1.4 Computerised CDS in general

CDS can be provided in many ways by electronic means. Published work and the current research shows that popularly used systems such as PMSs, the Internet, and email can provide CDS (Engelbrecht et al., 2004a, 2004b; Grant et al., 2006). This is achieved in a variety of ways, including through the incorporation a range of eCDS tools, such as alerts and reminders, which have been discussed above (Coiera, 2003; Gillies, 2005). Such tools can be stand alone systems or can be embedded in other multi-function systems. eCDS also exhibits a range of features which justify its description, and have been described in the literature (Kawamoto et al., 2005; Metzger & MacDonald, 2002) and explored in the current research. Such systems, tools and features were evident in the PHOs studied in this research, with member GP practices enjoying a high level of IT in international terms (Didham, et al., 2004). However, the usage of technologies to provide support for CDM varied greatly throughout the PHOs, and its improved use throughout the organisations could be achieved with the help of information provided by this study. Individuals and practices participating in the research utilise their system for eCDS to varying degrees, due to a variety of reasons. PHO-MS should therefore consider employing a range of solutions for different functional units, to equalise the utilisation of IS for eCDS in their organisations. The availability of eCDS appears to be increasing within the PHOs studied, as new systems are being introduced by PHO-MSs, and their usage encouraged in order to fulfil reporting requirements.

7.3.2 Question area 2: Information processing requirements

"Are your information processing needs being met?"

This part of the interview schedule provided answers to the research question **'Are PHO health professionals/managers' information processing needs adequately provided for?'**

7.3.2.1 Information Gathering

GPs face problems associated with information overload in their daily work (Ely et al., 2002; Hunter, 1997; WAVE Advisory Board, 2001), and studies have shown that doctors need rapid answers to their queries or questions can remain unanswered (Ely et al., 1999; Smith, 1996). Alper et al. (2004), studied the literature reviewing capacity of physicians trained in medical epidemiology, and estimated it would take each 627.5 hours per month to evaluate articles relevant to primary health care (ibid.), illustrating the difficulties facing GPs in keeping abreast of new knowledge. Many consider the use of IS as a way of addressing some of these problems and reducing the burdens faced by health professionals in their every-day work, for example, by providing access to timely and accurate information (Barnett et al., 2004; Hanka et al. 1999; HISSC, 2005; Smith, 1996; WAVE Advisory Board, 2001). This part of the research explores data gathering experiences of health professionals working in the PHO environment.

Issues were found to be mostly related to systems integration, time limitations, and staff skills. Interviewees from both PHO-MS and practices in all PHO cases, commented on the need to have better systems integration in some form or other, in order to be better able to gather needed information and data, and keep abreast of new knowledge. Having all GPs in one PHO using the same PMS was expressed as important by PHO-MS staff, and managers at one PHO thought that 'cumbersome procedures' could be improved with an integrated system. Several interviewees spoke of how they were beginning to 'pull' practice data. However, there were practices in each PHO where the use of different systems was favoured for a variety of reasons.

Not all practices were fully utilising Internet technologies. This could to due to special circumstances, but was often by choice and appeared to be changing with PHO incentives. Connection to email and the Internet was not available for all practice nurses, even though others in the same practice might be connected.

Some mobile staff needed better systems integration when off site. One doctor wanted better integration for more timely information on patients he was treating who had been seen by health care professionals elsewhere, better linkages with his PHO, and more contact with other GPs. Another wanted CDS to be more integrated with his system, and would like to have more time to increase his use of the Internet.

Time resource limitations and challenges connected with accessing data when needed, i.e. timely access to data, were mentioned by others in both management and practices. Managers from 2 PHO-MS commented on the need for more timely access to prescription data. The need for better structured and more timely information was expressed by one GP, with another explaining the problems associated with historical data and Read code entry, which were hampered by a lack of time and resources.
The need for greater levels of aggregated clinical data, and better communications with external agencies were desired by some PHO-MS staff, whilst others needed additional training and support with software use, and how to access useful information.

Other practice comments were for more accurate data, the ability to contact appropriate people who had required information (which was seen as a ‘people thing’), further training in information processing, and more support with a PMS system atypical in the PHO. Some practice staff indicated they lacked confidence with IT due to their age, and one doctor had not utilised her systems fully despite good support being available on-site.

Both management and practice staff in the two main case studies, stated that they were able to collect all the data they needed, with comments varying from positive ones about improvements being made all the time, and support being provided by the PHO-MS, to more negative ones, such as that the future was likely be challenging and that practices were coping with information overload. Broadband and home access were greatly appreciated, and national level improvements in data processing were expected in the near future.

Quantitative data suggested that GP practices in PHO 3 experienced a greater ability to access the information required for CDM than those in PHO 2, with those in PHO 2 expressing a stronger feeling that information required for CDM could potentially be better accessed with new computer systems, or improved use of existing computer systems. However, caution is necessary in drawing such conclusions due to the small number of respondents.

7.3.2.2 Reporting

Many GPs are leaving or retiring from practice and replacements are often difficult to find, and a 2006 report suggested that increased paperwork associated with PHO requirements has contributed to the burden of GPs (RNZCGP, 2005, 2006). The reporting needs of PHO managers and practitioners was studied in this research and discussed in this section.

From the PHO-MS perspective, managers at all PHO-MS indicated that their reporting efforts could be improved, with the senior managers in the pilot study saying they were not yet able to deliver all needed reports, and improved systems were required. The ability to access good data with improved software, better data recording at the practice level and easier access to practice data, were amongst improvements required. One PHO-MS staff member thought PMS systems were not yet ready and changes at the practice level needed encouragement. A senior manager felt that their response times could be improved but was dependent on other organisations to provide timely data. Some staff members at two PHO-MS organisations required increased support using software and accessing needed data.

For member providers, the provision of assistance with data collection, with the intention of their PHO-MS to collect practice data automatically, was seen by some practice members as a positive move, provided that only amalgamated data, rather than identifiable individual data, was collected. It was felt that this would also contribute to reduced workloads and better observation of the patient population. Many practice staff said they were able to provide needed reports, although reporting requirements were greater under the PHO and were likely to continue increasing. This had resulted in extra staff being employed to cope with the extra workload in one of the practices where interviews were held. One area cited for improvement was that surrounding the speed of responses by PMS vendors to user requirements, for example, in updating query bases. More help with querying from PHO-MSs was also signalled, as was help with initiating and maintaining up-to-date databases. Some practices using minority

PMS systems or remotely located needed more PHO-MS support for reporting. Another practice needed assistance with internal network issues which inhibited the ability of staff to run queries easily. Available PHO-MS resources in terms of access to individuals with PMS skills being available to help with query building, and a data analyst in the IT team, were acknowledged as helpful to practices in reducing reporting difficulties.

Quantitative data indicated that PHO 3 practice staff felt better able to produce needed reports than PHO 2, but PHO 3 practices gave only a slightly lower score for their estimation of the extent that new computer systems, or the improved use of existing computer systems, could potentially improve their reporting. This suggests that although practices in PHO 2 might have been experiencing more reporting difficulties, factors other than their systems could have been considered important. The finding of this study, that practices have experienced increased workloads since joining their PHOs, is in agreement with the RNZCGP report (2006), and some areas where their reporting challenges could be diminished, or even alleviated, have been identified.

7.3.2.3 Information processing needs/data issues

Data issues described by PHO–MS staff of two PHOs included data duplication, and the need for reliable and complete data from government agencies. National systems were said to have failed to keep up with changes at the PHO level, although it was acknowledged that improvements were underway. The need was stated for national level developers to work with health care end users, and ministry level decisions regarding information acquisition to involve specialist IT personnel capable of facilitating practice level reporting.

Performance management programme data needed to be provided to management staff in a more useful format, at a more appropriate level of aggregation, although DHBNZ data was otherwise described as well targeted and presented, and an analyst had recently been made available for feedback. Human resources for regular reporting were said to be stretched at the pilot PHO. Reliable, clean and accurate provider data from one type of PMS was desired, as was integrated population data, and this was seen as an area where PMS vendors could respond faster to PHO needs. Practices reported issues surrounding quarterly funding data, and practices in the pilot study felt their PHO-MS were slow to respond to problems, and unable to provide adequate explanations. Quantitative information indicates that practices in one of the main PHO cases might be experiencing more data issues than those in the other, and which could potentially be eased with new computer systems or the improved use of existing systems. An open ended question indicated that better systems integration, and more training in the use of PMS systems would be helpful.

7.3.2.4 Information processing requirements in general

The PHO-MS and GP practice staff in the participating PHOs required improved systems integration, to be better able to gather needed data and fulfil reporting requirements, for example, by improving the integration of mobile staff systems with base systems when off-site, the communications between PHO management and their member practices, and between GP practices. They also needed accurate, timely, well structured data, and for PMS developers to respond faster to their requirements for integrated population data and system updates, to work with health care end users, and for IT specialists to be familiar with practice level reporting. High quality provider data from a single brand of PMS was desired by PHO-MS staff, but some member practices still preferred to use a different type of system and there was often a need for increased user support where this was the case.

Some management staff required increased support and training in the use of software and accessing needed data, and a proportion of practice staff needed training and support in utilising their existing practice systems, their use of the Internet for information gathering, and data handling. Practice staff also needed support in dealing with information overload, including that generated by PHO membership. Published literature and the current research acknowledge that GP practices have experienced increased reporting needs since joining their PHOs (RNZCGP, 2006). New computer systems, or the improved use of existing computer systems were considered by many to have the potentially to improve CDM within PHO organisations, and PHO-MS support provided in these areas was considered important and acknowledged. Privacy issues were of concern to some informants and need to be addressed as information sharing increases.

7.3.3 Question area 3: Impacts of PHO establishment

“What changes have the PHO made regarding CDS within the organisation (for management and/or providers?”

This part of the interview schedule provided answers to the research question **'Can/how can IS support for CDM within PHO’s be improved?'** *

HIT adoption has been observed to progress at a slow rate with individual health providers, but given increased financial resources, and being part of a larger integrated health care system is likely to promote faster, HIT adoption (Fonkych and Taylor, 2005; Poon et al., 2006). A study of clinical practice computerisation in Hong Kong found a relatively low level of computerisation in most individual practices, compared to those which were part of corporate organisations (Leung et al., 2001). Poon et al., (2006) studied HIT in US by researching the adoption levels and barriers to adoption associated with a range of technologies providing major functionalities desirable for eight stakeholder groups, including physician practices, focusing on systems with the potential to improve patient safety, care quality and organisational efficiency. Systems associated with financial benefits exhibited a greater adoption level than those associated with quality and safety improvements, and the authors felt that HIT adoption would continue to be limited without increased financial resources becoming available (ibid.). Physicians practices were found to be particularly vulnerable in terms of financial constraints and increased workloads (ibid.). In a report for RAND Health, Fonkych and Taylor (2005) concluded that:

> The strongest evidence that HIT adoption spreads within a short time across integrated healthcare delivery systems suggests that a potential target for policy incentives is the corporation rather than the individual providers (p. 50)

Interviewees in the current study discussed how PHO membership had affected them, including their ability to derive CDS from their computer systems. They spoke of the challenges they were facing, discussed barriers to their increased use of computerised CDS, and of the level of support they were receiving from their PHO-MS.

The pilot study revealed the rapid changes being implemented in a newly formed PHO. The PHO-MS staff needed improved computer systems, and training in the use of existing software, and were understaffed in the IT support area. These challenges could have been minimised with increased resources. New positions were being created and the organisation was still undergoing structural changes. Attempts were being made to improve systems integration within the PHO by encouraging all practices to use the same type of PMS, and some data collection from the practices was undergoing automation, where it had recently been done manually. Some financial assistance was available for practices needing to change their PMS systems, and software facilitating automatic data collection was provided by the PHO-MS. The member practices were coping with increased workloads, particularly with respect to changes they had needed to make to their systems in anticipation of PHO establishment, and although they were currently able to fulfill their reporting requirements, were expecting those to increase in the near future.

The drive to have all practices using the same type of PMS was also present in the two main PHOs studied, but in each one, despite their being established for longer, there were still a few practices which had not taken advantage of incentives offered to change. Various reasons for this reluctance signalled the need of different approaches for their resolution, for example, through additional staff training or resources directed at easing limited staff time resources. Practice systems' IT support was provided privately and funded by the individual practices, although support for PHO related computerised activities was provided in both main PHOs. The need to equalise practice IT standards was being addressed in different ways in the two organisations. One PHO-MS was newly offering to provide a full IT support service including security measures, under contract to its practices, in the hope of establishing a consistent standard throughout the organisation. This incentive was appearing to be met with reluctance from the practices due to financial constraints. The other was seeking to establish cost effective secure messaging connections for its rural practices who could not take advantage of the PHOs local network and intranet. This was proving to be challenging due to resistance from a commercial supplier. In terms of support for PHO related activities, distance from the PHO was also possibly an issue, even though a travelling support person was available. One organisation provided increased support when a practice was adopting a new system, with visits before and after the vendor's initial instruction programme, while the other had recently decided to implement a PMS orientation programme. Both PHOs were introducing new systems into their organisations with various levels of funding for practice level implementations, and a pilot programme for a new DSS was planned in one organisation. Several individuals commented on being able to appreciate improvements to services, despite having increased workloads, but some doctors felt they were not getting enough support from their PHO. The quantitative data supported the view that there had been an increased need for data collection and reporting for both practice groups, since joining the PHO. One group appeared to have had more hardware and software changes, and more help with the reduction of barriers to the use of their computer systems for CDS. The other group signalled they had received more PHO-MS help of a financial or technical nature, felt more confident of their abilities in fulfilling processing needs with their computer systems, received more information supporting CDM since joining the PHO, and experienced the use of more communication media. Open ended questions provided several negative comments regarding PHO-MS support, giving indications of improvement areas.

Increased data requirements within PHOs are being met by increased investment in new technologies and additional activities by management and practice staff. The combination of pressures to meet data requirements, together with resource support provided by the PHOs, appear to be hastening the rate new technologies are being implemented within the organisations studies, including those providing CDS. Current initiatives should be maintained and further investment made to support the adoption of new systems.

7.3.4 Question area 4: Barriers

"Do you perceive any potential barriers/enhancers to the improved use of IS for clinical decision support in your work?"

This part of the interview schedule provided answers to the following research question: **'What factors influence the use/further use of IS for decision support by PHO health professionals/managers. What do PHO health professionals/ managers think about factors influencing their use of IS in clinical decision support?'**

During the initial evaluation exercise of the CDS programme, PREDICT^{TM} , Wells and Jackson (2005), identified a number of potential barriers to its successful adoption, including wide differences in practice hardware and software, and varying skills and comfort levels in practitioners' use of CDS programmes. Other important issues were the system's credibility and order of content, and its format, functionality, and adjustability. On-going support from the wider health care organisation, after initial implementation, was also found to be important for the system's continued use (ibid.). In the UK, Short et al., (2004) conducted a qualitative study of barriers to the use of a computerised DSS for risk assessment during GP consultations, and found that time restrictions were an issue. The authors also identified concerns about the system's effects on the doctor/patient relationship, user skill levels, barriers caused by infrequent use, and problem associated with both GPs' and patients' abilities in interpreting risk assessments provided by the system being studied. There are a number of issues presenting potential barriers to the use of computers in CDS, found to be present in PHOs studied in this research. The results are discussed below with suggestions for barrier reduction or removal. The items fall into two general areas: that of technical issues, and another of organisational issues. Technical issues include:

- hardware;
- software;
- system performance;
- and security (of information).

while organisational issues include:

- cost;
- credibility of information;
- training;
- knowledge of appropriate systems/tools;
- time (workloads);
- Skills/degree of comfort using CDS programmes;
- ability to fully utilise PMS features;
- on-going systems support;
- reading from computer screens;
- typing ability;
- staff resistance;
- intrusiveness of computers; and
- privacy.

In addition to the potential barriers listed above, others identified in the research included 'vendor support issues', which could contribute to both lists, together with extensions to the organisational issues list in the form of:

- information overload:
- restrictions on access to systems or data;
- fear of using the computer;
- cultural insensitivity of using computers in certain situations; and
- effects of fast paced organisational changes.

Cost issues were evident with both PHO-MS staff and practice staff, and were discussed by individuals in all PHOs. Issues with financial resources, software support, and systems maintenance were recurring themes, as were the need for on-going systems support and additional training. Many hardware issues were likely to be related to cost, and were of concern to PHO-MS staff in terms of providing cost effective networks, and equalising practice IT systems within the organisation. Practices were generally resigned to the need to finance periodic upgrades on their systems, but were considered by some PHO-MS staff to be reluctant to make changes. Comparison of quantitative data from the practices indicated that one PHO generally reported lower scores for barriers than the other, and also had a greater concentration of technical issues with low level scores. Although caution should be exercised when drawing conclusions with such small numbers of survey respondents, the data suggests that with fewer technical problems, organisational issues are more important, such as the need for training with systems that are in place, with lower ratings for barriers in general possibly indicating greater satisfaction with systems.

7.3.5 Question area 5: Ideal systems

"What would your ideal system be like?" This part of the interview schedule provided answers to the research question **'Can /how can IS support for CDM within PHO's be improved?'**

Administrators indicated their ideal systems would include improvements to health service systems with better quality, and more timely data. CDS within the PHO environment would be enhanced by research, evaluation, and relationships with other organisations. There was a need for practices to all function at a similar level with IT, and with the use of a common PMS system, and GP change agents would be considered helpful in encouraging others to make improvements in their practices. Doctors generally appreciated their PMS systems for providing some level of CDS. One pointed out that CDS "…needs to be evidence based, practical, pragmatic, summaries or reviews on management of medical conditions…". Several doctors said their ideal PMS would support the automatic population of fields when importing patients' notes. However, others were more traditional, favouring support from paper based sources of information during their consultations.

Improved communications were cited as important for CDS in the future, with a stated need for contact lists. Other simple improvements could come with the use of lap-top computers, Internet connections, or remote access to base systems, where none were currently found. Recent implementation of new software was evident in all cases, with many management and practice staff looking forward to resulting increases in CDS, and feeling positive about new DSSs being developed. Resource support, including finance and training, from the PHO-MS organisations was needed for the adoption of many of these technologies. The centralisation of systems was favourably viewed by some of both PHO-MS and practice members, provided privacy issues were resolved. The collection of data through recently installed systems was seen as a useful move in this direction. Doctors held varying opinions on the subject of centralised systems, with some being quite positive provided patient privacy was maintained. However, others felt that patient data needed to be retained at the practice rather than PHO-MS level. Privacy issues will need to be addressed further as information sharing increases.

In determining the use of IT by New Zealand GPs, practices were asked about their computerisation and technologies, and were found to have a high level of both, with most practices also being able to exchange information electronically with other providers. When compared internationally, New Zealand practices rated amongst the most advanced in this respect (Didham et al., 2004). However, Gillies (2005) outlined the background of computer based support for clinicians and pointed out the slow rate of adoption of CDS technologies. This research indicates that in general, practices taking part in the postal survey had been using PMS systems for some time, with a mean of 7.2 years for pilot study practices, 10.1 years for PHO 2, and 9.2 years for PHO 3. However, all were experiencing rapid changes in their organisations, including the introduction of a number of technologies with the capacity to increase CDS within their practices and the organisation as a whole. The implementation of these systems was being subsidised to varying degrees by the PHO-MS organisations, which in turn were driven by Ministry requirements. Increased workloads on the practices was evident, as was the need for support of various types in making the necessary changes to accommodate new systems and procedures. A mandatory component was detected in that, although the practices were private businesses within the PHO organisation, and therefore could determine their own courses of action, they had little choice but to make changes, or else be financially disadvantaged. Therefore the voluntariness of systems adoption was becoming a factor in their choices. Where PHO support was provided it was appreciated, although the need for more was often voiced. Several practice staff commented that they could see the changes were leading to positive outcomes, although several doctors felt they were experiencing scant support from the PHO-MS. However, the prospect of new systems, or extensions to their existing systems was often positive despite the challenges observed. Research has shown that physicians were atypical from subjects of many other technology adoption studies, in that perceived usefulness scored more highly with them than did ease of use. This was thought to be, in part, due to their high level of capability and ability to master new systems (Chau and Hu, 2001, 2002a, 2002b). Work by Chismar and Wiley-Patton

(2003) was in agreement with the finding that perceived ease of use was not predictive of the intention to use a system, whereas perceived usefulness was an important determinant, in their study of the intentions of paediatricians to use Internet-based health applications. Therefore, the adoption of new technologies being implemented by the study PHOs and the capacity of the technologies to provide increased CDS, appear to have every possibility of progressing well, and apparently faster, than would have been the case if the practices were not part of the larger organisational structure, provided appropriate support is available.

7.3.6 Question findings and eCDS improvement areas

Answers to the questions discussed above have provided a wealth of material on the subject of the use of eCDS in PHOs. Findings from each of the questions were listed in Chapter 6, and can be divided into five major areas where there is the potential to influence improvements in eCDS. These areas are as follows:

- User support
- Systems' improvements
- Systems' integration
- Equalising organisational systems
- Privacy of information

Recommendations in each of these areas are made in Chapter 8.

7.4 The eCDS Utilisation Model

7.4.1 Introduction to the eCDS Utilisation Model

A model of the utilisation of eCDS in the PHO environment was developed from this research through the comparison and interrogation of qualitative data and the emergence of themes. The model is illustrated in Figure 7.1. The diagram illustrates five stages of practice eCDS utilisation determined by this research, increasing from stage 1, and shows their relationship to the PHO-MS. Information sharing between management and practices at each stage of eCDS utilisation is needed for PHO staff to meet the needs of their enrolled populations, including the care of individual patients and the population as a whole. Although all practices studied possessed a range of computer technologies, including PMSs there was a wide range of utilisation of available systems for the provision of eCDS. Practice members expressed varying attitudes and requirements regarding eCDS, as documented in the analysis chapter. This information indicates that PHO management efforts at equalising practice performance should address the varying needs at different stages of eCDS utilisation.

Stage 1 of the eCDS Utilisation Model represents a primarily paper based practice where IS are present but hardly used, and stage 5 of the model represents the level of systems integration just being reached within the study PHOs. Integration falls short of totality but does enable PHO-MS to access practice data to a certain extent, via data mining client software and arrangement with the practices. Further progression beyond this stage would require considerable debate with respect to patient privacy and data ownership issues. The inclusion of a completely paper based stage with no computerisation at all (stage 0), and the theoretical stage of total systems integration within the PHO, possibly including the centralised hosting of records (stage 6), would extend the model to a seven stage version.

7.4.2 Model description

The model illustrates the increasing utilisation of eCDS within the New Zealand PHO environment. The PHO management service and PHO member GP practices are depicted, with information sharing represented by block arrows. Stages 1-5 of the eCDS Utilisation Model, represent the range of eCDS usage found amongst GP practices belonging to medium sized PHOs. Stages 1-3 are more likely to represent solo or small GP practices, with Stages 4 and 5 corresponding to larger, multiple GP practices. Various arrows indicate different types of incentives/support needed for practices at the five stages. The broken outline block arrows illustrate increasing IT sophistication at both PHO management service and practice levels, attained in the area of eCDS. The introduction of additions to PMSs, plus other eCDS systems, as a result of increased requirements and initiatives within the PHO environment, provide increased functional, technological, and integration sophistication, in and between the management service and the member practices. Descriptions of the five stages are as follows:

Stage 1: No practice level eCDS

Stage 1 is characterised by the presence in a practice, but lack of use, of information technologies commonly found in GP practices in the PHOs studies. Although a computer, complete with a sophisticated PMS, and broadband Internet connection, may be present, it is little, if at all, used, possibly being restricted to word processing for some administrative purposes only, with no electronic recording of patient records or doctors' notes, no use of email, the Internet, or electronic communications via secure messaging systems. Fax. machines are used, and manual, paper based methods are employed when communicating with PHO management services. There is no evidence of eCDS utilisation.

Stage 2: Limited practice level eCDS

A Stage 2 practice employs available systems mostly for administration and prescribing (administration plus minimal patient management/care). They may have networked computers with a PMS, but no there is no electronic recording of doctors' notes, and the doctor uses the computer system sparingly. There is no use of email in the practice and use of the Internet is either non-existent or limited to occasional secure messaging, for example, for minimal electronic integration with the PHO management service. There is some use of a Fax. machine, and eCDS is limited to recall reminders, and drug interaction information.

Stage 3: Some practice level eCDS

Although a Stage 3 practice's computer systems, for example networked computers, PMS, email, the Internet, and secure messaging, may be used for administrative and clinical purposes (administration plus patient management/care), their use is mainly by practice staff other than the doctor, and no doctor's notes are stored electronically. A dual paper/electronic system may exist for some records. Fax. machines are used, and there is minimal integration with PHO management via secure messaging. Some eCDS is derived from drug interaction information, recall reminders, risk assessments, discharge summaries, and x-ray reports.

Stage 4: Increasing practice level eCDS

In a Stage 4 practice, available systems such as networked computers, a PMS, email, Internet access, and secure messaging, are well used for administrative and clinical purposes (administration plus patient management/care). Electronic recording of doctors' notes is carried out by most GPs at the practice, and other staff also use the systems, although some may not have access to email or Internet facilities. There is minimal integration with PHO management, via secure messaging, but new technologies are being introduced e.g. smart forms, preparing for increased integration within the organisation. There is an increasing level of eCDS with varying use of popular systems, tools and features, with most used to some extent.

Stage 5: Advancing practice level eCDS

At Stage 5, a practice has available systems which are well used for administrative and clinical purposes (administration plus patient management/care). It has networked computers, a PMS, email and the Internet are extensively used, and there is use of secure messaging, and systems for increased Internet security. Doctors' notes are recorded electronically, and the integration of practice/PHO management data is increasing with the introduction of new systems (e.g. data mining software). Increased eCDS is achieved through the introduction of additions to PMSs, plus other eCDS systems, often as a result of initiatives within the PHO environment to meet reporting requirements.

Management Service Level:

In order to fulfil PHO objectives, PHO-MSs conduct a range of services which require the acquisition of data from a variety of sources, including Ministry of Health organisations and PHO member practices. PHOs are mandated to improve health care for their member patients by including a focus on addressing health issues at the population level, and therefore their management services need to collect good quality data. This includes data on their patient population and clinical and evidence based information. The data assists in decision making regarding projects, initiatives and so forth within the PHO, which will impact on decisions made by clinicians at the practice level. In addition to the data being of good quality, it also needs to be available in a timely, accessible and secure form and, with this aim, improvements to computer systems and their integration are taking place throughout the PHOs participating in the research. eCDS is provided at the management service level by PMSs, email, the Internet, spread-sheets, and databases, and is moving to include data mining software, websites, etc., and in addition to developing their own systems' capabilities, PHO-MSs are providing both incentives and support for their member practices to improve their systems and/or to make changes. In order to obtain the organisational benefits which are provided by improved eCDS through the acquisition of appropriate data, its facilitated analysis, and improved sharing/integration of information at management service (population), and practice (patient) levels, PHOs have sought to elevate their member practices to a common level of functionality in information processing, or IT sophistication. It is evident that increases in the utilisation of eCDS are taking place throughout the PHOs, signalling increasing IT sophistication.

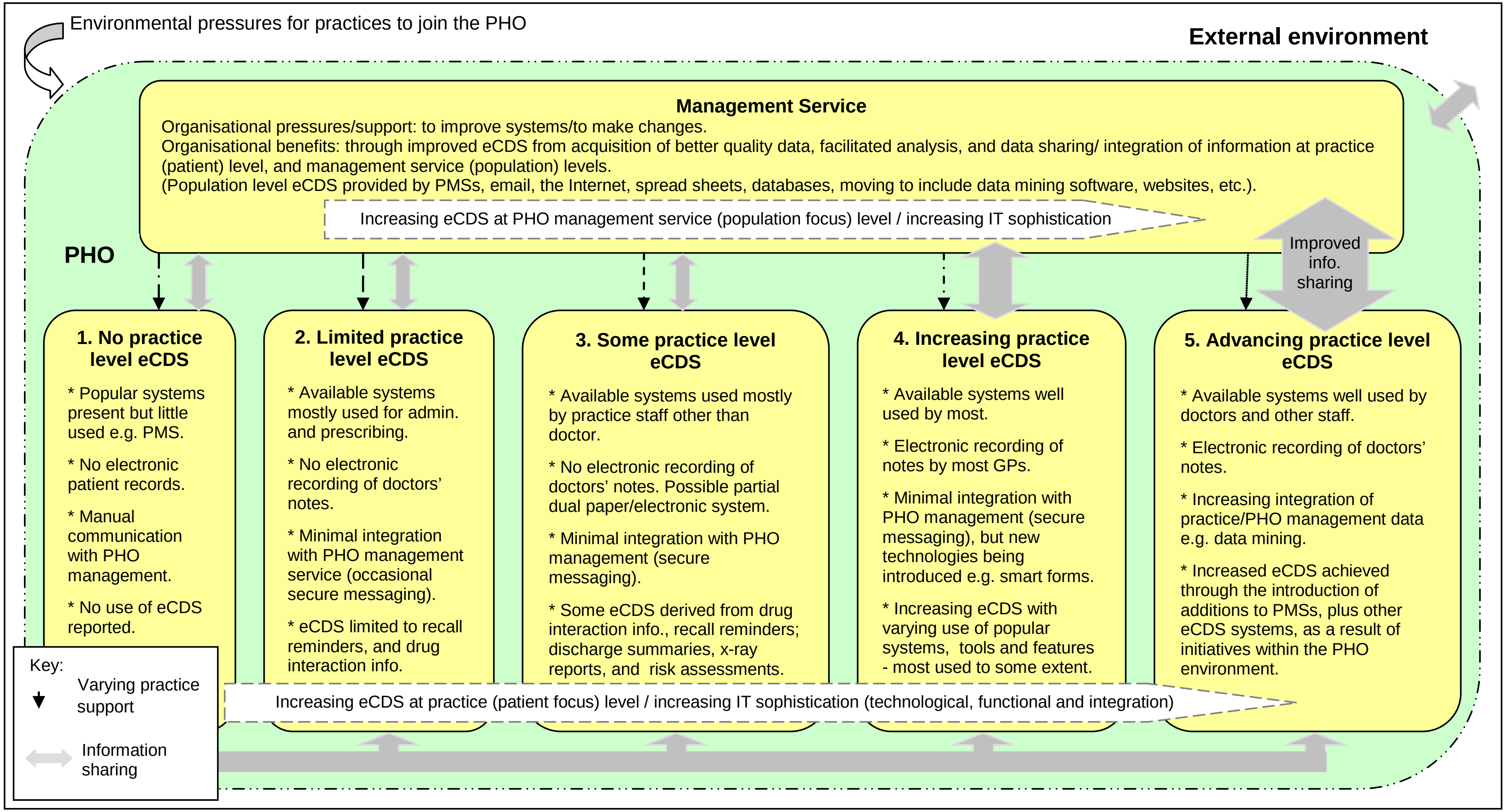

Figure 7.1: The eCDS Utilisation Model

However, the existence of a range of practice stages of eCDS utilisation have been identified, and a number of issues regarding the utilisation of eCDS in PHOs have been noted amongst these stages, by this research. As practitioners have varying attitudes to, and requirements for, their utlilisation of eCDS, so their management service organisations need to employ a variety of strategies to support practices at different stages within their organisations. For example, practices of Stages 1-3 might be limited in their use of eCDS through one or more factors, including comfort with existing procedures, loyalty to current systems and providers, lack of time available for 'non-computer-savvy' staff to up-skill, for example, in the area of data entry and typing abilities, fears for the security of data, resistance to change by valued employees, lack of finances for new systems, or lack of training or on-going systems support. Whereas Stage 4 practices might be limited by time and training/support issues, or be awaiting systems' developments, having overcome many issues already. By ascertaining practices' individual circumstances, PHO management could direct appropriate support to each until such time as a common level was enjoyed by all.

Most practices fitted one of the identified stages, although exceptions were possible, for example, where one practice was potentially at Stage 4 but experiencing limitations with outside communications, more appropriate at Stages 1-2. Therefore, assistance with resolving that practice's particular challenges, had the potential to elevate it rapidly by several stages. At the time of the study many practices were at Stage 4, beginning to transition to Stage 5, and new software was being introduced in all three PHOs. This included data mining software, increasing integration of management and practice systems. It was evident that since joining their PHOs many practices had made changes to their systems, and were increasing their utilisation of eCDS, even though many had used PMSs for many years. Postal questionnaire results reported mean years of regular practice use of a PMS as 7.2, 10.1, and 9.2, for PHOs 1, 2 and 3 respectively. This acceleration of decision support technology utilisation amongst the practices appears to correspond to the rapid rise in innovation adoption experienced after an initial lead phase (Rogers, 1962; 2003). It also echoes the findings of Van de Venn et al., (1999) who suggested that innovation in an organisation often follows a crisis or critical event, in this case perhaps corresponding to the formation of the PHOs and health service pressures for GP practices to join them while retaining their status as private practices. Changed and increased data reporting required by the PHO structure has had to be accommodated. Similarly, the UTAUT model (Venkatesh et al., 2003) includes voluntariness as a moderating influence in a user's choice to adopt a system, and in the case of GPs, pressures exist for them to not only join a PHO, but to increase their use of computer systems in order to conduct their businesses and ultimately be paid.

The five stages of practice eCDS described by the model correspond to a certain extent with the five levels of IT systems architecture that were developed for use in this study and based on the quintet used by Paré and Sicotte (2001), see Section 6.3.2.6, and illustrate increasing levels of systems integration. However, Stage 1 of the eCDS Utilisation Model represents a practice where eCDS is available if not utilised, rather than a completely paper based environment, and Stage 5 of the model does not match the highest level of IT architecture, the 'Totally Integrated System' and potential Stage 6, with the scenario:

'Our systems run on a totally integrated practice network where users potentially have access to all data from any computer. There is no duplication of data and functions performed by many different individuals can all be tied together'.

The interaction with the PHO-MS with practices at each stage of practice eCDS utilisation is important for eCDS at both management and practice levels as there is a need for information to pass between them to inform decisions influencing clinical practice throughout the PHO. Clinical staff need CDS, but management staff also need information for their decision making regarding the health of PHOs' enrolled populations, and this in turn affects the work of clinicians in the organisations. By elevating all member practices to Stage 5, the sharing of information will be improved, and the potential for further developments in eCDS utilisation realised, provided appropriate controls for the privacy of patient information are agreed upon.

7.4.3 Contribution of the eCDS Utilisation Model

The model of eCDS utilisation described above illustrates the variety of practice and management use of eCDS present in medium sized PHOs in New Zealand. It will assist researchers in characterising the domain of eCDS, thereby providing the opportunity to study the area further and in different situations, for example, in larger PHOs in New Zealand, or health care organisational structures in other countries. Practitioners can use the model to evaluate the status of their own practices, allowing comparison with others in the same organisation, and PHO management can use it to overview their organisation, pinpointing opportunities for improvement, and comparing their organisation to other PHOs. eCDS developers will also find the model of use as a source of information on the status of practices, and their challenges and requirements. The model of eCDS utilisation can therefore be used to guide evaluation by, and actions of, health care professionals in the pursuit of improvements to the utilisation of technologies for the support of CDM in their organisations. With a profile of eCDS utilisation within an organisation, planners can appropriately direct resources at elevating the performance of member units to a common level.

7.5 Research quality

7.5.1 Validity

This research sought to clarify how eCDS is utilised by management and health care providers in the PHO environment, with the aim of identifying ways to maximise any benefits of the use of such technologies, in the organisation. To be considered valid, theory must be well-grounded, relevant and meaningful (Merriam-Webster, 2008c), features which are demonstrated in this research. Yin (2003), discusses several ways of increasing construct validity in case studies as employing multiple sources of evidence for convergent lines of enquiry, establishing a chain of evidence, and having the report reviewed by key informants. Multiple sources of evidence have been use in the study, including semi-structured, face-to-face interviews, postal questionnaire surveys, and the collection of documentation. The framework for part of the postal questionnaire was adapted from published international research on health care IT, with the final question items provided by iterative development through the pilot study, and final two case studies. Questions relating to the utilisation of eCDS technologies, and barriers to their usage were based on current literature, or findings from the pilot study, and subsequent case studies. A detailed plan of the research was developed prior to the study, and a QSR NVivo 7 database project of findings was constructed, in order to enable comprehensive access to the data (see section 4.3.3). Where findings are presented, a chain-of-evidence is provided through the analysis of each question area, whereby the study of each separate case is followed by a cross-case study, with references to the sources of the evidence.

7.5.2 Reliability

Further corroboration of the research findings are made possible by following the details provided by the research plan, documented in the research design and data collection chapters, together with the semi-structured interview schedule and questionnaire. The QSR NVivo 7 database developed during the research includes data organised in tree structures to facilitate its analysis and referencing. References included in the analysis enable a chain of evidence to be followed, and the reliability of the report to be substantiated (Yin, 2003).

7.5.3 Generalisability

Generalisability, or external validity, is concerned with determining if the research findings are generalisable beyond the case study (Yin, 2003), and defining the domains for which a study's findings are relevant. The current research findings, including the questionnaire developed during the research, can be generalised to medium sized PHOs in New Zealand. However, research with much bigger PHOs, would require the research to be repeated, including interviews and the generation of an appropriate set of questionnaire items, as would research based in similar organisations in other countries. During the case study design a multiple study consisting of three case study organisations, each with approximately three embedded units of analysis, was chosen. In order to include as many opinions as possible, a doctor, a nurse, and an administrator, were interviewed where possible. The choice of appropriate embedded units, in this case the GP practices, was informed by the PHO management service organisations, with the aim of including practices covering the range of IT capability in the organisation. The PHOs were recruited either as a result of convenience and prior connections, as in the case of the pilot case, or because they responded to a letter of invitation from the researcher. PHOs 2 and 3 were the only respondents from a total of 11 PHOs contacted and invited to take place in the study. The group of PHOs contacted included medium (10,000-100,000 enrolled population) and large PHOs (>100,000 enrolled population), in the lower part of the North Island of New Zealand.

7.5.4 Limitations

As the research was conducted for a PhD Thesis, it was subject to restrictions in cost, time, and human resources, and was therefore limited in size. As the PHOs included in the study were of medium size, the postal questionnaire could not be sent to enough GP practices to generate sufficient responses to allow statistical analysis to be carried out, beyond simple proportions. The results are only generalisable to medium sized PHOs in New Zealand.

7.6 Summary of the discussion

Profiling the IS used in organisations provides useful information, but does not necessarily provide insight into how technologies are being used or how much they are utilised for certain purposes. To obtain a picture of the value derived from IS by practices one needs to know if a technology is being used rather than languishing in a cupboard or only being switched on for a short time to perform its function occasionally. The framework used in this study takes into account this need and acknowledges the importance of systems integration. Results of this study, focusing on the use of IS for CDS, demonstrate wide differences between PHO practices in their utilisation of available technologies for CDS in both the pilot PHO (Engelbrecht et al., 2006, 2007a, 2007b) and PHOs 2 and 3. For example, PMSs are used for a variety of tasks which provide CDS as well as administrative functions (Didham et al., 2004; Engelbrecht et al., 2004a, 2004b), but some practices only use a limited number of their systems' functions. The most powerful and integrated systems will not be used for optimal CDS if practice staff have limited time, skills or inclination to exploit them in that way. If the lack of technologies to support decision making is the sole reason for a lack of CDS, then practices with a high level of appropriate technologies should have higher levels of CDS, but this research indicates otherwise.

A study of US physicians concluded that most of them did not use "basic, inexpensive, and widely available IT tools in clinical practice" (Grant et al., 2006). The current study shows that respondent practices of three New Zealand PHOs are using a wide range of available IT and is in agreement with findings that New Zealand primary care practices are at the forefront of general practice IT adoption and use, with almost a 100 percent rate of computerisation (Didham et al., 2004). The usage of IT by individual respondent practices does reach 100 percent for some technologies such as PMS, but varies with respect to technology types and their utilisation. The pilot study indicated that within one PHO, PMSs, the Internet and email, previously identified as having the potential to provide CDS in GP practices (Engelbrecht et al., 2004a, 2004b), were used by a high proportion of practices but by fewer practices actually for CDS (Engelbrecht et al., 2007a, 2007b*).* There was little evidence that increased practice size corresponded to increased technology infrastructure, but contrasting findings on practice size and use of IS for CDS (Engelbrecht et al., 2006) indicated that the use of email in CDS was more prevalent in larger practices, and an absence of use of PMSs, the Internet and email for CDS was more likely to be found amongst the smaller practices studied (ibid). This latter finding supports US research which shows that practice size can influence the adoption of IT in health care, and that single practitioner and small practices are less likely to use new technologies and are likely to have a slower adoption rate than larger practices (Audet et al., 2004; Fonkych & Taylor, 2005). However, the level of technology infrastructure was found to be high in the organisations studied, and although smaller practices were equipped, for example with email, it did not automatically follow that they would use email for CDS. This suggests that beyond a certain point IS infrastructure ceases to have as much influence on systems use than other factors, i.e., once technology saturation is reached, other factors become responsible as barriers to adopting the technology for CDS.

Barriers have been discussed by other researchers, including cost, time, credibility, and skills in using CDS programmes (Leung et al., 2001; Short et al., 2004; Wells and Jackson, 2005). This case study of New Zealand PHOs identified a considerable number of potential barriers to the improved use of computer systems for the support of CDM, and found that resource and organisational issues such as training, cost, knowledge of appropriate systems/tools, and time (workload), were most important, while technical and systems considerations, although still identified as potential barriers, were less important. One exception was hardware, which rated highly as a barrier with PHO 2 practices, although this result could have been related to hardware costs. As having access to a range of technologies within an organisation or even within one practice does not necessarily guarantee either use or optimal use in terms of CDS, resources directed at reducing some of the identified barriers could result in better use of existing technologies and advantages gained through enhanced CDS. However, results indicate that a “one size fits all” policy in support or barrier removal might not be appropriate, and the very individual nature of member practices needs to be taken into account when designing technology initiatives.

Results regarding eCDS tool use illustrate that while some practices find certain tools useful, other practices may not be taking advantage of them at all. As these tools can be provided by PMS, through the Internet or as stand-alone systems, the potential exists for increased utilisation of available systems to ease the GPs’ CDM and administrative burdens. One finding about eCDS features, was that respondents did not think their systems provided the three features ‘Bring information to the point of clinical decision making’, ‘Provide decision support automatically as part of the workflow’ and ‘Provide actionable recommendations’ to any great extent, and ranked them within the lowest four places in the pilot study and lowest of all features in PHOs 2 and 3. These features have been described as being three of the four most important indicators of the ability of CDS systems to improve clinical practice (Kawamoto, 2005), and this result indicates that efforts should perhaps be directed at encouraging their use. Although the provision of CDS features provided by practice systems varied in the opinion of the respondents, it is possible that some systems were capable but not fully utilised. Systems might not have been set up to advantage, staff could have been unaware of some aspects of their system's capabilities, or useful modules or extensions to the software may not have been included at installation.

This study also indicates that technologies which have the potential to provide CDS, e.g., risk assessment software, have not been found to be currently widely used within the PHOs studied. Examples of such software include that which can assist chronic disease management through, for example, cardio-vascular and diabetes risk assessments. Given that chronic disease management in population health is a focus for PHOs, and there is interest in software supporting such management, this study suggests that a two-part strategy might be appropriate for the introduction and implementation of such systems. Firstly, the technologies should be available but, secondly, attention should be paid to their utilisation. The eCDS Utilisation Model illustrates different stages evident amongst the PHO practices studied, and can be used by PHO managers, together with other information provided by this research, in formulating strategies to facilitate eCDS adoption throughout their organisations. Groups of PHO practices could be compared with those at other PHOs, and practitioners could compare their own situation with that of their peers. Additionally, the model provides information valuable to researchers who wish to study the domain of eCDS in primary health care.

This research has provided a framework for the determination of IT sophistication in GP practices, explored the use of IS in the support of CDM, informed the construction of a model of eCDS utilisation, and identified five areas of importance to eCDS, in New Zealand PHOs. Suggestions have been made for other ways the framework could be applied, for example, by using one comprehensive questionnaire survey at the PHO level to compare groups of PHOs. It could also be used in an extended form to include eCDS. The research has answered the research questions, and offered explanations for the research findings, which will be of value to organisations in planning and policy making. Five areas of importance in eCDS utilisation have been identified and recommendations from these are made in Chapter 8. The conceptual model presented in this chapter illustrates eCDS utilisation found within medium sized PHOs, and contributes to the study of eCDS and its evaluation by practitioners, managers and researchers.

8 Conclusions and Recommendations

8.1 Introduction to the conclusions and recommendations

This chapter concludes the thesis with comments about the use of mixed methods in the study, IT sophistication in PHOs, and answers to the research questions. Recommendations from five main areas with the potential to influence the improved use of computers for the support of CDM in the PHO environment, and comments on future strategy, then follow. The contributions made by the research are stated, limitations explained, and areas for future research outlined.

8.2 Conclusions

8.2.1 The use of a mixed methodology

The mixed method approach used in this study has provided a rich insight into the use of currently available technologies by PHO health professionals in primary care. In addition to the use of a quantitative survey tool, developed iteratively through qualitative study, a qualitative approach was also used to determine details of CDS use of IS in the study organisations. Analysis of the qualitative results revealed information which suggested reasons for many of the quantitative findings, and identified barriers to the better use of IS in CDS experienced by the study participants. The collection of documents from participating organisations contributed to triangulation in the research, and fostered a deeper understanding of IT infrastructure, organisational structure and activities in the organisations.

Such an approach is recommended in future projects assessing IS in health care organisations as it not only gives an inventory of available technologies, but elucidates the amount and how they are used, their levels of integration, and the opinions of their users. The research indicates that PHO organisational structures have the potential to influence a rapid increase in the use of sophisticated decision support technologies within their organisations which could elevate primary care IS usage to a higher level of sophistication. Changes are already taking place, and in subsequent years it will be determined if the use of these technologies has helped to provided the solutions expected of them in supporting the improvements in the health care system which are currently sought.

8.2.2 IT sophistication in PHOs

New Zealand is internationally recognised as being ranked amongst the most advanced countries in terms of its adoption of primary health care IS, but whilst this view is supported by this research, the use of IS in the support of CDM by PHO practices has been found to be variable with scope for improvement. Also, the structure of a medium sized PHO, comprising a number of independently owned health care practices with a separate management service organisation, was found to encompass practices which were well equipped with IS, with a high level of practice systems integration, but an overall PHO-MS/member practices structure which was less mature. This was characterised by both a lower level of integration between PHO-MSs and their contributing practices, and the fact that many of the management staff respondents at the time of the study had limited IS support for the analysis they were increasingly required to do. However, this picture appeared to be rapidly changing with newly commissioned technologies being adopted, for example data mining software, of a type that practices would be currently unlikely to invest in on their own due to cost, skill and support challenges. Therefore, the rapidly changing picture of IS in primary care indicates that the membership of single practices in PHOs appears to be hastening the adoption of more advanced technologies which can support CDM within the PHO, advancing the sophistication of both the practices, and the PHO as a whole. Van de Venn et.al., (1999) described how shocks can serve as stimuli to innovation, and can take many forms such as new organisational leadership or budget crises. Innovations can experience long gestational periods with rapid changes only taking place after such input. Primary care computerisation has had a long gestation period in New Zealand practices, but its employment for CDS appears to have been underutilised to some extent. It is possible that pressures associated with the cost and delivery of health care services and the formation of the PHO structure based on capitation based funding will provide a turning point for primary care computing. Computer based information systems are seen as technologies which can provide support to solve some of the problems in today's health care environment and the adoption of new technologies within PHOs at both the practice and PHO-MS levels, with the potential to increase CDS, appears to be underway.

8.2.3 Research question answers

The use of eCDS in the organisations studied was the focus of the following five research questions:

- How are IS used in the support of clinical decision making by PHO professionals?

- How do IS used for clinical decision support meet PHO professionals information /reporting needs?

- What are the barriers to/what factors influence the use of IS for clinical decision support by PHO professionals?

- What IS useful for decision support are available but not used in the PHO environment?

- How can the use of IS for the support of clinical decision making in PHOs be improved?

A summary of answers to each research question follows:

- *How are IS used in the support of clinical decision making by PHO professionals?*

Through the development and application of a framework for the determination of IT sophistication in medium sized New Zealand PHOs, the range of IS used in the study organisations and the extent of their usage, the activities/processes supported through their use, and the levels of systems integration, were determined. These components, for both patient management and care, and administrative purposes, were determined by interviews with PHO management and member GP practice staff, and a postal questionnaire of remaining GP practices. Those systems used in CDS were identified during the case study interviews and through the postal questionnaire. The results confirmed findings from other research that indicate that primary health care practices in New Zealand are well supplied with IS, with a subset of those systems found to be used for CDS, including PMSs, the Internet, and email, but the use of stand alone CDSS was found to be limited. Analysis of pilot study questionnaire results indicate that the amount of use of commonly available systems in CDS varied between GP practices, and these results were confirmed in PHOs 2 and 3. Within individual PHOs, GP practices can have similarly high levels of IS in some areas, which should enable them to achieve similar levels of CDS to each other by utilising available technologies, but there is evidence to the contrary. There are wide differences in the use of existing IS to support CDM by the GP practices studied, and results indicate that a proportion of practices could benefit from incorporating some additional use of IS for CDS in their routines. The quantitative component of this thesis was focused at the GP practice level of the PHO, and illustrates a way for PHO management organisations to assess and compare their member practices, and practices to monitor their situation with respect to others in their organisation. The framework and survey tool are scalable to the PHO level and would allow similar observations to be made of and between entire PHOs. During face-to-face interviews the three PHO management organisations participating in the study provided data on their activities, the IS supporting those activities, and details of their systems' integration. The results presented in discussion form in Chapter 6 show similarities in activities, technologies, and integration between the organisations, despite their differing organisational structures. However, there were different approaches to providing secure messaging systems for their practices. Interview material, from both management and practices, together with the quantitative data from the practices, has been used to provide answers to this and the following research questions, and information on the current state of IS adoption within medium sized New Zealand PHOs.

- *How do IS used for clinical decision support meet PHO professionals information /reporting needs?*

Results revealed that some PHO health professionals, including managers, community workers and practice staff, do not think their information/reporting needs are being met by their current systems. New systems or the improved use of existing systems, increased personal training and support, and on-going systems support were amongst areas mentioned where improvements would be of benefit.

- *What are the barriers to/what factors influence the use of IS for clinical decision support by PHO professionals?*

A considerable number of barriers to the use of IS in CDS were identified in this study, including potential issues in the following areas: training; costs; hardware; knowledge of appropriate systems/tools; time/workload; skills/comfort using CDS programmes; on-going systems support; credibility of information; ability to fully utilise PMS features;

typing ability; security; privacy; reading from screens; software issues; finding computer use intrusive during consultations; system speed; staff resistance; access to systems or data; information overload; fear of using computers; cultural sensitivity issues; vendor issues, and the fast pace of change. Most of the highly rated barriers were found to be non-technical in nature, suggesting that once a certain level of IS infrastructure is reached other barriers become important. The wide range of concerns expressed by individuals suggests that a 'one size fits all' approach to improving eCDS would not be effective. Five major areas influencing improvements in eCDS in the organisations studied were found to be in various forms of user support, systems' improvements, integration, equalising organisational systems, and privacy of information.

- *What IS useful for decision support are available but not used in the PHO environment?*

There was evidence that a number of health professionals were aware of other PHOs which had improved IS, for example, where new CDSS were in use, where another PHO management organisation was better able to utilise pharmacy and laboratory data, or where the predominant PMS used in another PHO was providing a function not available on their PMS. However, no mention was made of systems outside the PHO domain.

- *How can the use of IS for the support of clinical decision making in PHOs be improved?*

This research provides knowledge about IT sophistication in PHOs, and how IS infrastructure is utilised to provide CDS within the organisations studied. The use of eCDS in PHOs can potentially be improved by employing knowledge derived from this study. Firstly, the identification of issues surrounding the use of IS for the support of CDM in PHOs, provided by this research, gives evidence of areas which need to be addressed, particularly for some member practices. Secondly, the model of eCDS utilisation developed illustrates the range exhibited within medium sizes New Zealand PHOs, and suggests the need for multi-faceted approaches for the advancement of eCDS utilisation within such organisations. With reference to this model, and by addressing the issues identified by the research, the MoH, DHBs and PHO management organisations should be able to improve the use of IS for the support of CDM by different functional groups within PHOs. As PHO membership expands to encompass a wider range of providers, the knowledge gained from this study will be of value in facilitating their integration into the PHO system. This could be particularly important as many of these providers are likely to have completely paper based systems with no computerisation (Stage 0) or be at Stage 1 of the eCDS Utilisation Model where they have some IS but are using them very little. Further information relevant to this question is reported below in the recommendation section.

8.3 Recommendations

This research has adapted and applied a framework, and developed a survey tool, for the study of IT sophistication in the PHO environment, and has presented a model of eCDS utilisation by PHO practices. The assessment tool provided by this study can be used by PHO management organisations to compare the IT sophistication of their contributing practices using an approach which provides a platform for benchmarking. Practice staff could also use its results to gauge their organisation's performance against others in their group. The framework can be scaled to include PHO management services and other providers at the PHO level, and the iterative mixed method development process used to provide a similar assessment tool to compare PHOs of greater size and complexity. This would allow MoH/DHBs a method of comparing groups of PHOs. By referring to the model of eCDS utilisation, together with other information provided by this research, MoH, DHBs, PHOs and practices should be able to direct attention to the reduction of barriers to the better use of IS in the support of CDM within primary care, identified in this study. Positive comments reported regarding PHO membership can provide insight to foster improvements in other PHOs. The information provided by this research therefore, will be of use to organisations, practitioners, planners, systems developers, and researchers in the pursuit of improvements to eCDS and its utilisation. During qualitative analysis emergent themes also resulted in the identification of five main areas of importance in eCDS utilisation. These five areas are now presented, and potential improvements described, which could contribute to the better use of eCDS within PHOs.

8.3.1 Five major areas influencing improvements in eCDS

8.3.1.1 User support

PHO-MS and practice staff need support with the establishment of new organisations and fast paced restructuring exercises, for example, through early IS support within the organisation, or additional human resources for regular reporting as were needed at the newly formed pilot PHO-MS. Factors in addition to technical ones are important. The negative effects of fast paced organisational changes can be minimised with support for new projects by the prospective user groups, senior level change agents or project champions, and full consultation and inclusion of staff from the early stages of systems development projects. GP change agents would be helpful in encouraging others to make improvements in their practices. Also, sufficient resources should be available to provide practice staff with support in training for, and the implementation of, new systems. Practices would benefit from assistance with pre-organisation establishment tasks, and the increased workloads generated by greater data collecting and reporting needs. Increased resources should be available for equalising practice level IT and its support. Practices would benefit from the alleviation of one or more of the range of inhibitors to their improved use of their PMSs, and rural practices could need more resources and support from their PHO-MS, including visits from support staff. Resource support, including finance and training from the PHO-MS organisations, would facilitate the adoption of many newly introduced technologies.

Measures to improve users' abilities with their PMS would be likely to increase the use of those tools embedded in the system, such as alerts and reminders, prescribing support, and diagnostic assistance/assessment tools. Where patients' notes were not stored electronically, a practice's ability to exploit their systems capacity is limited, indicating that practice use of electronic notes should be promoted, where it is still lacking. Focused evidence-based health information use could be encouraged by enabling potential users to have better web searching techniques, guidance on the choice of useful sites, access to PHO or MoH intranets, and improved skills using their PMS. Assistance with search techniques might also benefit individuals who have time limitations. By providing appropriate support during and after their implementation, systems being newly introduced appear to have the potential to considerably elevate available CDS, and already seem to be well received by practitioners. These new systems have the capacity to improve areas such as risk assessment, therapy planning and critiquing, as well as improve reporting. The need for additional training and support with software use and how to access useful data and information was signalled by, and for, some PHO-MS staff also. However, practice staff need more support with PMS issues from their PHO-MS or vendors, including when new systems are introduced. Support for practice staff with Read coding issues and good quality data entry would benefit both PHO-MS and the practices.

Practices need support in dealing with information overload and increased workloads. Increased practice workloads could be eased, for example, with added resources made available for extra staff. PHO-MS assistance with initiating and maintaining up-to-date databases, and querying them, should be readily available, and remotely located practices or ones using minority PMS systems sometimes need more PHO-MS support for reporting. Practices might also need support with IS issues which could inhibit their ability to run queries easily, such as system speed/capacity issues. System performance should be equalised to a similar, high level between PHO practices, through improved IT resources.

Quarterly funding data issues need to be addressed, with timely PHO-MS support for practices experiencing associated problems. Health department data quality should continue to be improved, and practitioners should be supported in being able to access quality data sources through their available technologies. There is a need for support with systems to be on-going throughout PHOs. Personal contact with a PHO support person, or in-house IT specialist would be welcomed, and vendor support should be more available. Doctors with typing issues might benefit from added resources. Both managers and practice staff would like to have a greater knowledge of systems and/or tools which could assist them in their information gathering activities, and increased skills and comfort in using CDS programmes, and would appreciate more time to accommodate additional computer related tasks.

Restrictions on access to systems or data can be alleviated by training, or resolving organisational issues, and increased training and knowledge would alleviate many difficulties involving the fear of using computers, lack of confidence due to age, finding computers intrusive during consultations, and potential cultural insensitivity surrounding the use of computers in certain situations.

8.3.1.2 Systems' improvements

The study finds that new computer systems, or the improved use of existing computer systems are considered by many study participants to have the potential to facilitate a greater ability for the access of information required for CDM within PHO organisations. Many PHO-MS staff members require improved systems, including improved software and reductions in data duplication, and feel that practices should be functioning at a similar level with IT, with the use of a common PMS system. PMS system capability should be enhanced, eCDS should be increasingly integrated with the PMS, and changes at the practice level encouraged appropriately. Practitioners facing typing limitations might benefit from speech recognition software which is now becoming faster to configure.

Anticipated national level improvements in data quality and processing should be realised, with government agencies providing reliable and complete data. System developers need to work with health care end users and IT personnel with understanding of reporting requirements at the practice level. Attempts by PMS developers to respond faster to user requirements, for example, in updating query bases, would be welcomed. It was suggested that, software vendors should also, ideally, communicate better with each other when changes made to one vendor's system could impact another's, and exhibit more ownership of problems generated by system updates.

The continued or increased introduction of systems with more automated features would facilitate greater CDS, and the facilitation of access to new integrated risk assessment tools and CDSS would be welcomed by many managers and practitioners, who are anticipating increased eCDS from recently introduced software, and are positive about new DSS being developed. PMS systems should be able to integrate new patients' historical notes automatically, populating appropriate fields.

Broadband and home access were greatly appreciated by those reporting their use, and should be easily available to all health professionals where appropriate, but there are indications that increased use should be made of available modes of communication within PHOs. Lap-top computers, Internet connections, and remote access to base systems would therefore benefit some off-site workers.

Information overload experienced by practice staff could be reduced with the use of anti-spam or increased system security where lacking, and additional adjustments by developers to prescribing software which currently provides too many alerts, resulting in it often being ignored or switched off by practitioners. The latter was mentioned by many individuals and appeared to be a major issue. Security issues involving practice systems need to be addressed with all practices supported to achieve a similar, high level of security.

Increased financial resources would ease cost issues, identified as major barriers to increased utilisation of eCDS, particularly in relation to hardware and software upgrades and maintenance, and support issues within PHOs. Where possible, PHO-MS funding for the implementation for improved computer systems, should be continued, for example, for secure messaging services, the provision of cost effective private networks, or internet security systems.

Results from the current study, indicate that efforts should be directed at improving the use of the three eCDS features: ‘Bring information to the point of clinical decision making’, ‘Provide decision support automatically as part of the workflow’, and ‘Provide actionable recommendations’, which have been found to be amongst the most important indicators of the ability of CDS systems to improve clinical practice (Kawamoto et al. 2005), but are very limited or not being provided at present in PHOs.

8.3.1.3 Systems’ integration

PHO-MS staff require timely access to prescription data, and better communications with external agencies. Clinical data e.g. performance management programme data, is required in a more useful format, and at a more appropriate level of aggregation, however, moves towards improvement have been acknowledged. National systems need to keep pace with changes at the PHO level, although improvements here have also been signalled as underway. Where possible, PMS vendors should respond promptly to PHO needs for integrated population data. Improved systems integration is required in order for health professionals to be better able to gather needed data. Being able to extract practice data automatically is seen as important by PHO-MS staff, and better data recording and easier access to data at the practice level should be improved where possible. Improvements to health service systems need to include the provision of better quality and more timely data in general.

CDS within the PHO environment would be enhanced by research, evaluation, and relationships with other organisations, and improved communications would facilitate this. Such simple measures as providing easy communications with current contacts would be useful, including the use of e-mail address lists, as there is a need for practice staff to be able to contact appropriate people who possess required information. All appropriate practice staff, for example practice nurses, should be able to take advantage of email and the Internet if they wish. Staff working off-site, such as community nurses, should have good integration with their base systems, including Internet and email connections, better linkages are needed between GPs and PHO management, and more contact between GPs should be facilitated. Timely sharing of patient information between providers should be facilitated, particularly when a GP would like updates on a patient treated elsewhere. Therefore, well structured, timely and accurate information should be available for GPs. The use of the Internet for information gathering would be increased if more time was available, and there is a need for increased time and other resources to facilitate historical data and Read code entry in practices, which will be needed for future reporting purposes. Improved systems integration with other providers such as those in secondary care, will enable greater use of expert opinions/systems, especially with reference to such eCDS as image recognition and interpretation. Continuing improvements to data collection and the PHO-MS support being provided, which are acknowledged in this report, should be maintained.

8.3.1.4 Equalising organisational systems

PHO-MS staff expressed preferences for member practices within their PHOs to all be functioning at a similar level with respect to their IS, systems security, communications, and to be using a common PMS. This was seen as important for the efficient collection of data, and sharing of information. Some practice staff who were using atypical systems reported experiencing disadvantages, despite the choice of systems being their own, indicating that additional support for the use of their current systems, for example for query building, would be appreciated. Where many individuals recognise the advantage of using the same system as others in their PHO, others preferred to use alternative systems. Issues such as a lack of choice through one vendor developing a monopoly would need to be avoided. Efforts to encourage alignment of systems within organisations would need to focus on identifying the needs in individual practices or functional groups, and appropriate incentives implemented case by case. This would also need to include attention to varying usage patterns by individuals within, for example, each practice.

8.3.1.5 Privacy of information

Further adoption of eCDS will partly depend on resolving issues surrounding the privacy of personal information, from the perspectives of managers, practitioners and the public. This study reported concerns voiced by some individuals representing PHO management and practices. Most practitioners needed to feel confident that patient privacy is protected when information is shared, and the automatic collection of data from practices by PHO-MS should be accompanied by the reassurance that only amalgamated data, rather than identifiable individual data will be collected. Doctors held varying opinions on the subject of centralised systems, with some being quite positive provided patient privacy was maintained, but many doctors felt that patient data needed to be retained at the practice rather than PHO-MS level. Any plans for the centralisation of systems would need to be accompanied by full discussion with stakeholders, particularly with respect to privacy issues, and this should also apply to newly installed data collection/mining software.

8.4 Importance of a national strategy

The national strategy for health information in NZ is important because a coordinated effort is needed to provide appropriate systems which will support the improvements in service provision and budget control, needed to meet current and future opportunities and challenges in the health system. Solutions to some of the current issues can be provided by efficient and effective IS, and the development of appropriate standards. This research shows there is the potential for improvements to the utilisation of eCDS within primary care, facilitating subsequent benefits. However, it is difficult for small organisations such as individual providers to bring about change, and assistance through membership of larger organisations appears to encourage the adoption of IS, as observed in this study. Consistency is needed for providers in their available systems, systems performance, training and on-going support, and could be delivered more efficiently and effectively if coordinated from a higher organisational level. Isolated initiatives can result the duplication of efforts by, and added expense to, PHOs and practices, for example, in the provision of security for systems and data transfer. Therefore a strategic framework for the deployment of primary health care IS, including those providing CDS, should focus on providing parity of IS across practices and PHOs, coordinated possibly at national level, but taking into account the perspectives of the individual providers. Elements of the strategy should include:

- good communication and consultation with stakeholders throughout the primary care sector to determine end-user requirements for the support of appropriate systems utilisation, including stakeholder involvement in decisions on the privacy and confidentiality of health information;
- the accommodation of the diversity of requirements at user level, for example, for new PHO member providers lacking former IS experience or adapting to newly integrated systems, or patients and their carers using telecare systems; and
- funding targeted towards providing readily available and affordable training and on-going systems support for better utilisation of IS, together with improvements

to current systems and the implementation of new technologies, including the standardisation and security of PHO and practice systems.

Strategic elements for improved eCDS

Health care services are evolving with increased information sharing and integration of IS, a greater emphasis on care at the primary level, a wider range of services provided by PHOs and practices, and patients being increasingly empowered in aspects of their care. This will be accompanied by the use of a greater range of technologies, and a wider end-user community. For example, the use of mobile technologies in healthcare has the potential to make a large impact on data collection and the delivery of services by enabling the collection of data on the conditions of home based patients and providing timely responses. Also, the use of expert systems such as those which provide image recognition and interpretation, little used by the GP practices in the current study, will possibly change with the widening scope of primary care practices and increasing integration with secondary care systems and clinical support services. These changes will require a re-organisation of roles and processes and careful change management, incorporating training for both practitioners and patients in order that benefits are forthcoming.

These issues will be less challenging if current ones are firstly resolved. During this research data quality issues were evident, concerning data from various sources including national and practice levels. Much needed improvements were recognised as being implemented at the national level, and it was suggested that improvements at the practice level would be gained through support to establish good data handling skills, and incentives provided by useful and timely feedback. It was also suggested that fast responses to user requirements by PMS vendors would also facilitate this process, and advice for practices from a PHO data analyst should be easily available. Some PHO staff also expressed the desire for further support with data handling. Both practice and PHO-MS personnel stated the need for patient privacy and confidentiality to be protected through secure systems and procedures. Practice staff stated the need to be assured of strict limitations to data access, where information was shared. Therefore, national and industry primary care IS development efforts need to be tightly coordinated with user requirements, through good communications with PHOs and their member practices, and be responsive to end-user opinions.

Good communication of information between all stakeholders of the health system including the MoH, system developers, end-users, and others, will help to facilitate both the development and adoption of high quality IS. Thorough consultation and iterative development with end-users ensures that appropriate and usable systems are successfully developed, and the use of these and other new and successful technologies will be sustained through appropriate support for users, including financial support where necessary and possible.

In the current study, the PHOs exhibited similarly diverse levels of eCDS utilisation amongst practices, despite mostly high levels of available systems, suggesting that the presence of IS does not necessarily guarantee their optimal usage. There are indications that the use of new systems by health care providers, to satisfy reporting requirements, is hastening the adoption of new technologies and increasing IT sophistication in primary care, possibly facilitated by PHO establishment. This situation could be leveraged for further improvements. Strategies to do this should take into account that local knowledge and contact are needed to best support end-users, including PHO member practices which are mostly private entities with staff having individual information processing needs, preferences and opinions which should be understood. Not all changes to practice systems are explained well to GPs and their staff and better communication would be advantageous in these cases.

Ideally, funding should be directed towards improvements to providers' systems and the support of their use through readily available and affordable resources, following guidelines from a national strategy. This could potentially lessen differences in GP practices' utilisation of IS for CDS, as practice staff currently receive varying amounts of support from their PHOs with IS issues, even within individual PHOs. The 'personal touch' in on-going systems support was found to be very important where it was available, and would be a welcomed resource.

Therefore, improvements to primary care IS and eCDS need to be underpinned by a local presence to gain knowledge of end-user requirements to provide efficient and effective support, but coordinated at a national level for consistency. Findings indicate that future IS improvements should include the exploration of individual practitioners' IS requirements and determination of tailor made solutions where possible, within the limits of national guidelines, with resources such as financial, training or on-going support being readily available, and preferably with personal assistance available i.e. the presence of support persons. Changing modes for the delivery of primary care services will require improved IS, more resources to support the increasing range of end-users, and the resolution of privacy issues which need to be addressed in order for providers and patients to be comfortable with increased data sharing. Research focusing on both the practitioners' and patients' attitudes to the sharing of health information will provide further insight into privacy issues which might need to be overcome in the future.

8.5 Contributions of the research

This research contributes to knowledge in four main ways. Firstly, it adapts and applies a framework, and provides a survey tool, for the study of IT sophistication in medium sized New Zealand PHOs. In turn, this has provided a foundation for the study of eCDS in the organisations. A further adaptation of the framework together with the iterative mixed method development process have the potential to determine the IT sophistication of PHOs of greater size and complexity, including PHO management services and other providers, via one survey tool. This would allow MoH/DHBs a method of comparing groups of PHOs. Secondly, the research presents a conceptual model of eCDS utilisation in PHO GP practices, which illustrates how practices within individual PHOs vary in their utilisation of eCDS. Thirdly, five areas of importance for the improvement of eCDS within PHO's are identified. This information, together with the conceptual model, will be of use to organisations, practitioners, planners, systems developers, and researchers in the pursuit of improvements to eCDS and its utilisation. Lastly, the research provides structure for the study of the primary health care eCDS domain which will be of help to other researchers in the area.

8.6 Limitations

The research for this thesis was limited by both financial and time constraints. The study provides information relevant to medium sized New Zealand PHOs and generalisability to smaller or larger such organisations cannot be claimed. The quantitative data derived from the postal survey represented a very small sample of GP practices and as such were unsuitable for further statistical analysis, and findings of a similar study conducted at a later date would likely show many differences due to the rapidly changing PHO environment and IS advancements. This would particularly apply to the pilot PHO which was newly established at the time of the study and undergoing rapid changes. Questions arising from the work should be clarified through further research.

8.7 Further research

Where larger sample sizes of practices are available, further statistical analysis would be possible. Additionally, the framework can be applied and a survey tool developed to provide a single questionnaire for use at the PHO level as illustrated in Figure 3.2. This would enable the comparison of IT sophistication between groups of PHOs. Studies using a similar approach have already been used to ascertain, for example, relationships between IT sophistication and clinical outcomes in health care organisations (Hart, 2006), and relationships between IT sophistication and the use of computer systems in CDS within organisations would be possible.

8.8 Summary of the conclusions and recommendations

This research offers a framework and survey tool for the study of IT sophistication in New Zealand PHOs, and applies it at the GP practice level to provide information on the types and amount of usage of technologies present, the activities/processes which they support, and the levels of integration found within medium sized New Zealand PHOs. Qualitative techniques were used in the development of the tool, and to determine comparable information on the PHO-MS organisations. The potential for the development and application of a similar survey tool for use at the PHO level, encompassing all functional groups, is described. Having established this foundation, the research focuses on the use of IS in the support of CDM throughout the PHOs studied. It provides detailed information derived from interviews and the survey, on the use of eCDS, and issues surrounding it, in the study organisations. Although New Zealand primary care is well equipped with IS, the utilisation of eCDS varies within organisations. The research presents a model of eCDS utilisation in PHO practices, which illustrates how practices within individual PHOs vary in their utilisation of eCDS. This, together with other information from the study, will support organisations, practitioners, planners, systems developers, and researchers in their pursuits of knowledge and improvements in the area. There is evidence that, with increased data handling requirements necessitated under the PHO system, new systems are being implemented and adopted at a rapid rate. By answering a set of research questions this research provides knowledge of the issues experienced within PHOs surrounding the fast paced organisational and IS changes, focusing on eCDS. It identifies five main areas important for the improvement of eCDS within PHOs with the potential to help in facilitating those changes: user support; systems' improvements; systems' integration; equalising organisational systems; and privacy of information, and details specific issues in each area. Recommendations and suggestions for future strategy are made.

Lastly, the research provides structure for the study of the domain of eCDS in PHOs or other similar organisations.

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10 Appendices

10.1 Appendix 1: General information

10.1.1 Study location

The following diagram shows the area chosen for the study with respect to the DHB areas: The eight most southern of the New Zealand North Island District DHBs comprising a total of 25 PHOs, 16 of which were established in 2002-3.

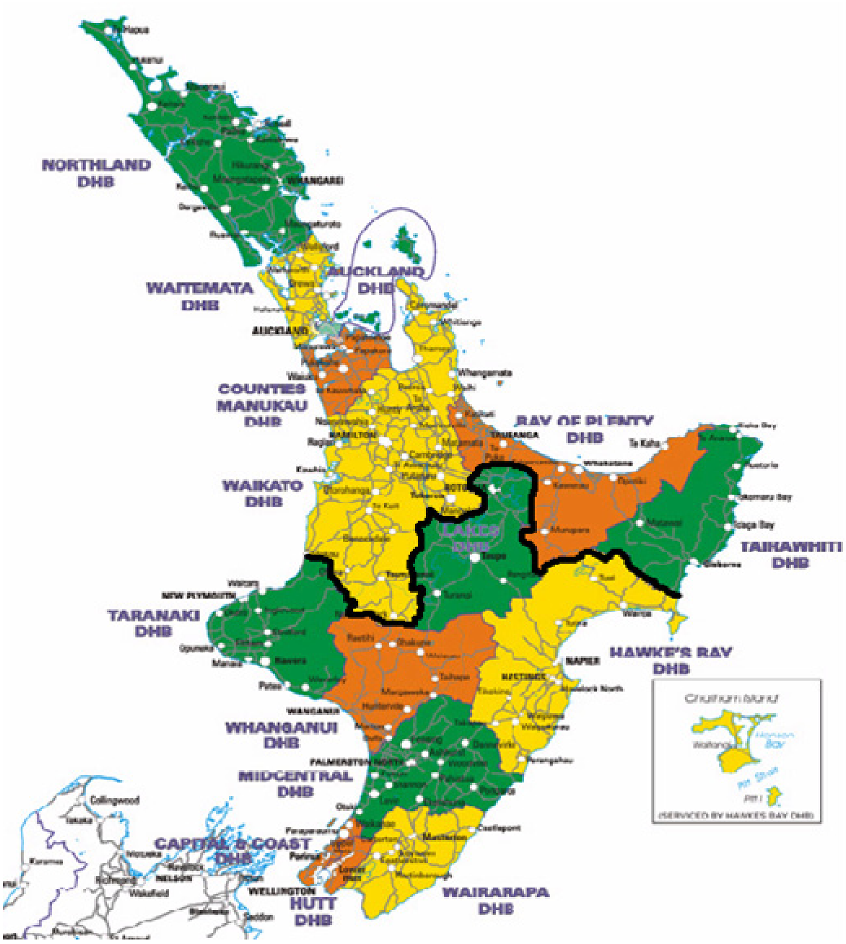

Figure 10.1: New Zealand North Island District Health Board Areas (based on Ministry of Health, 2009)

10.1.2 PHO details

Table 10.1: New Zealand Lower North Island PHO details

Details of the 25 established PHO's in 8 DHB areas of the New Zealand Lower North Island		
Population size	**No. of PHO's**	**Funding Formula**
<10,000	6	Access
10,000-100,000	17	Varied
>100,000	2	Interim/Interim + Access Practices

10.2 Appendix 2: Correspondence

10.2.1 Support for the study

Te Mauri O Rangitaane O Manawatu *(Council of Elders)*
Tanenuiarangi Manawatu Incorporated *(Mandated Iwi Authority)*
Phone: (06) 353 1881 Fax: (06) 355 1880 Email: TMI@rangitaane.iwi.nz

Best Care (Whakapai Hauora) Charitable Trust
(Health/Social/Education Services)
Ph: (06) 353 6385
Fax: (06) 353 1883
Email: BCWH@rangitaane.iwi.nz

Piki Kotuku
Te Awhi Hinengaro
Ph: (06) 353 1884
Fax: (06) 353 1885
Email: Piki.Kotuku@rangitaane.iwi.nz

Kia Ora 89.8 FM
(Radio Station)
Ph: (06) 353 1881
Fax: (06) 353 1880
Studio: Ph (06) 353 1882
Email: KFM@rangitaane.iwi.nz

Tūturu Pūmau
Te Hotu Manawa O Rangitaane O Manawatu Marae
140-148 Maxwells Line, PO Box 1341, Palmerston North

18 July 2005

Department of Information Systems
Massey University
Private Bag 11222
PALMERSTON NORTH

Attention: **Dr R Whiddet**

Tena koe
Nga mihi nui ki a koe i roto i nga tini ahuatanga o te wa nei

Re: Letter Of Support - Computerised Decision Support In Primary Health Organisations

1. Tanenuiarangi Manawatu Incorporated is the mandated iwi authority for Rangitaane O Manawatu located in Palmerston North. Through it s health arm Best Care (Whakapai Hauora) Charitable Trust, we provide a number of health services to the wider community of Palmerston North.

2. On Wednesday 13th July 2005, Dr Whiddet and Mrs Engelbrecht came to consult with Rangitaane O Manawatu on their project concerning computerised decision support in primary health organisations.

3. We believe that this is a very worthwhile and timely project. Now that PHO's are up and running, systems that support decision making will be an integral part of PHO's operations and with technology, it is imperative that we understand how computerised decision making can work effectively in PHO's.

4. Thus we are very supportive of the project and look forward to the outcomes of the findings in due course.

Heoi ano ra

D.P. Harris (Ms)
For Chief Executive Officer

Ka kahutia i te korowai, Te Rangimarie, Te Aroha, Te Whakaiti, Ka Whakapuawai he iwi humaarie
\\SBSSERVER\Users\Ginny\My Documents\2005 Computer Files\tmi\corr\July\prwhiddett dis 18Jul2.doc
Spread the cloak of Peace and Love, so shall blossom the people of humility

Figure 10.2: Letter from Te Mauri O Rangitaane O Manawatu (Council of Elders)

1 July 2005

Judith Engelbrecht

Doctoral Research Student,
Department of Information Studies,
Massey University,
Private Bag 11 222,
Palmerston North

Dear Judith

RE: Computerised Decision Support in Primary Health Organisations (PHOs)

I am pleased to advise that have met, discussed, and endorsed your proposed research project.

They share our view that for our PHOs Boards, and their primary health care providers, to make informed and prioritised decisions they need to be supported by good quality and well anaylised data.

Within this context intends to develop the competency and reputation for being an organisation able to source, aggregate and provide first line analysis of, primary health care and population demographic data.

Our intent to build relationships with individuals and organisations able to add value to this capability and thus create innovation in the way supports the district's PHOs and delivers health care programmes and support.

We are therefore very pleased to be able to confirm support of your project and look forward beginning the practical steps in the next few months.

Yours faithfully

CC: Dr. Inga Hunter
Dr. Dr. Richard Whiddett

Providing Comprehensive, High Quality Health Care based on General Practice

Figure 10.3: Letter from an Independent Practitioner Association/PHO-MS

10.2.2 Ethics approval

Massey University

OFFICE OF THE ASSISTANT
TO THE VICE-CHANCELLOR
(ETHICS & EQUITY)
Private Bag 11 222
Palmerston North
New Zealand
T 64 6 350 5573
F 64 6 350 5622
humanethics@massey.ac.nz
www.massey.ac.nz

19 July 2005

Judith Engelbrecht
Department of Information Systems
PN311

Dear Judith

Re: HEC: PN Application – 05/76
Computerised decision support in Primary Health Organisations

Thank you for your letter dated 14 July 2005.

Your application has now been reviewed and considered to meet the requirements of the Massey University Code of Ethical Conduct for Research, Teaching and Evaluations involving Human Participants. You may now submit your application to the appropriate Health and Disability Ethics Committee (HDEC) with a copy of this letter. Please note that Massey University has agreed to accept any changes made by the HDEC. However, please advise this office of any such changes and supply a copy of the HDEC approval. These documents will be placed on your file and will be referred to if any enquiries are made to the University about this project.

If the nature, content, location, procedures or personnel of your approved application change, please advise both the Secretary of MUHEC: Palmerston North and the Secretary of the approving HDEC.

Yours sincerely

J O'Neill

Dr John O'Neill, Chair
Massey University Campus Human Ethics Committee: Palmerston North

cc Dr Richard Whiddett & Dr Inga Hunter
Dept of Information Systems
PN311

A/Prof Chris Freyberg, HoD
Dept of Information Systems
PN311

Massey University Human Ethics Committee
Accredited by the Health Research Council

Te Kunenga ki Pūrehuroa

Figure 10.4: Massey University Human Ethics Committee approval

Health and Disability Ethics Committees

Central Regional Ethics Committee
Ministry of Health
10th Floor, 180 Molesworth Street
PO Box 5013
Wellington
Phone (04) 496 2405
Fax (04) 496 2360

9 November 2005

Ms Judith Engelbrecht
Dept of Information Systems
Massey University
Private Bag 11 222
Palmerston North

Dear Judith

CEN/05/08/053 - INFORMATION SYSTEM SUPPORT FOR CLINICAL DECISION MAKING IN PRIMARY HEALTH CARE: CASE STUDIES OF NEW ZEALAND PRIMARY HEALTH ORGANSIATIONS
Ms Judith Engelbrecht

Thank you for your e-mail of 6 November 2005 responding to the points raised in my letter to you of 17 August 2005. As all outstanding issues have been satisfactorily addressed, the above study has been given ethical approval by the **Central Regional Ethics Committee.**

Accreditation
The Committee involved in the approval of this study is accredited by the Health Research Council and is constituted and operates in accordance with the Operational Standard for Ethics Committees, March 2002.

Progress Reports
The study is approved until April 2008. The Committee will review the approved application annually and notify the Primary Investigator if it withdraws approval. It is the Primary Investigator's responsibility to forward a progress report covering all sites prior to ethical review of the project in November 2006. You will be sent a form requesting this information. Please note that failure to complete and return this form may result in the withdrawal of ethical approval. A final report is also required at the conclusion of the study.

Amendments
It is also a condition of approval that the Committee is advised of any adverse events, if the study does not commence, or the study is altered in any way, including all documentation eg advertisements, letters to prospective participants.

Please quote the above ethics committee reference number in all correspondence.

It should be noted that Ethics Committee approval does not imply any resource commitment or administrative facilitation by any healthcare provider within whose facility the research is to be carried out. Where applicable, authority for this must be obtained separately from the appropriate manager within the organisation.

Yours sincerely

Claire Yendoll

Claire Yendoll
Central Ethics Committee Administrator

Email: claire_yendoll@moh.govt.nz

Administered by the Ministry of Health   Approved by the Health Research Council   http://www.newhealth.govt.nz/ethicscommittees

Figure 10.5: Central Regional Health and Disability Ethics Committee approval

10.2.3 Questionnaire information sheet

Massey University
COLLEGE OF BUSINESS
Kaupapa Whai Pakihi

DEPARTMENT OF
INFORMATION SYSTEMS
Private Bag 11 222
Palmerston North
New Zealand
T 64 6 350 5233
F 64 6 350 5725
www.massey.ac.nz

Computerised Decision Support in Primary Health Organisations

QUESTIONNAIRE INFORMATION SHEET

Researcher: Judith Engelbrecht
Supervisors: Dr. Richard Whiddett; Dr. Inga Hunter

I am a student at Massey University, Palmerston North, studying for my PhD in Information Systems (IS). I am conducting research on the use of computerised decision support tools in clinical decision making within the Primary Health Organisation (PHO) environment. Your PHO has been selected as one of several which have agreed to take part in this case study. Dr Richard Whiddett, a senior IS lecturer at Massey University, and Dr. Inga Hunter, a member of the Royal College of General Practitioners and IS lecturer also at Massey University, are supervising my research.

As part of my thesis I am surveying General Practices belonging to the Whanganui Regional PHO in order to study aspects of their information requirements and use of computerised decision support during clinical decision making. I would greatly appreciate it if you could assist in this investigation by completing the accompanying questionnaire. It will take approximately 20 minutes. Through this questionnaire I would be asking you about the different categories of information that you require, how you access this information, and how computer systems support clinical decision making within the PHO environment. Total confidentiality of the data from your completed questionnaire is assured. The data will be held by myself and is accessible additionally only to my supervisors named above. The raw data will be analysed to draw conclusions. I will destroy this data by Massey University's approved disposal methods ten years after the completion of this study.

I am requesting that practices belonging to the participate in this survey. Please return the completed questionnaire directly to myself, Judith Engelbrecht, using the pre-paid envelope enclosed.

A summary of the findings will be obtainable by ticking the box on the return form at the bottom of page 1 of the questionnaire, or by contacting me at the addresses given below.

You have the right to:

- decline to participate;
- refuse to answer any particular questions;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the findings of the study when it is concluded.

There is no penalty from declining to participate or from withdrawing from the research project at any stage. It will be assumed that filling in and returning the questionnaire implies your consent to participate in this research.

Questionnaire Information Sheet

Page 1 of 2

Te Kunenga ki Pūrehuroa

Figure 10.6: Questionnaire information sheet - page 1

Please do not hesitate to contact myself or my supervisors if you have any questions about this study at the addresses below:

Judith Engelbrecht
Department of Information Systems
Massey University
Private Bag 11222
Palmerston North
Phone: 06 350 5799 x 7753
Email: J.Engelbrecht@massey.ac.nz

Dr. Richard Whiddett
Department of Information Systems
Massey University
Private Bag 11222
Palmerston North
Phone: 06 350 5799 x 2689
Email: R.J.Whiddett@massey.ac.nz

Dr. Inga Hunter
Department of Information Systems
Massey University
Private Bag 11222
Palmerston North
Phone: 06 350 5799 x 2686
Email: I.Hunter@massey.ac.nz

This project has been reviewed by the Massey University Human Ethics Committee: Palmerston North, Application 05/76. If you have any concerns about the ethics of this research, please contact Dr. John G O'Neill, Chair, Massey University Campus Human Ethics Committee: PN telephone 06 350 5799 x 8635, email humanethicspn@massey.ac.nz.

The project has also been approved by the Central Regional Health and Disability Ethics Committee (CEN/05/08/053).

Contact details for the Health Advocates Trust are: phone 0800 555 050, or (09) 623 5799
Contact details for Mid and Lower North Island advocacy are:

Postal address:	Lewis Ratapu (Manager) Advocacy Network Services Trust Inc. PO Box 782 Wanganui		
Phone:	0800 42 36 38;	0800 4 ADNET;	(06) 348 0074
Fax:	0800 2787 7678;	0800 2 SUPPORT;	(06) 348 0473
Email:	adnet@xtra.co.nz		

We hope that the aspirations of this research have become clear to you, and that the short time required to complete the survey will be worth your while. Thank you for taking the time to read this information.

Questionnaire Information Sheet

Page 2 of 2

Figure 10.7: Questionnaire information sheet - page 2

10.3 Appendix 3: Interview schedule and questionnaire

10.3.1 Final interview schedule:

Case Study Interview Schedule Overview: *Overall IT sophistication and IS support for clinical decision making in PHOs*

a) General demographic information collection, and preliminary discussion of Clinical Decision Support

b) IT Sophistication question areas:

	Administration	**Patient Management and Care**	**Clinical Support**
Functions	* *	* *	* *
Technologies (Hardware, software, devices)	* * *	* * *	* * *
Integration	* *	* *	* *

Functions:
Processes
Activities

Technologies (Hardware, software, devices):
PMS;
Level of patient note computerisation;
Organisation wide technologies;
Connectivity technologies;
Internet based technologies;
Others used in the organisation;
Others used in similar organisations

Integration (electronic and automatic transfer of information):
Between similar/different systems within the PHO-MS/practice;
Between similar/different systems within the PHO (between PHO-MS / practices / other providers);
Between the PHO-MS / practice and external organisations;
IT architecture self assessment

c) Clinical Decision Support (CDS) question areas:

In caring for your patients/patient populations, what types of computer support do you use in your clinical decision making? *Broadly based systems, CDS tools, CDS features*
How do the PHO-MS, practices and other PHO members communicate regarding info. for CDM? *e.g. by Healthlink, email, Fax., post, telephone, face- to- face or other means.*
Are your information processing needs being met? *Information gathering; reporting; unmet needs*
What changes have the PHO made regarding CDS within the organisation (for management and /or providers)? *How have these been planned/implemented? (Current projects; future plans)*
Do you perceive any potential barriers/enhancers to the improved use of IS for clinical decision support in your work? *Issues with hardware, software, cost, training etc.*
What would your ideal system be like?
e.g. What are your perceptions of CDS; What outcomes would you like to see from better use of CDS: What else do you need to support CDM?

10.3.2 Final questionnaire:

Computerised Decision Support in Primary Health Organisations

QUESTIONNAIRE for PRIMARY HEALTH CARE PRACTICES

Instructions

This questionnaire has been designed to collect information about the use of computers in the support of clinical decision making in a Primary Health Care Organisation. It is divided into two parts: Part Ⅰ assesses general information technology sophistication, and Part Ⅱ explores the use of computerised decision support, within PHO practices. Your help would therefore be greatly appreciated in providing information which reflects the present situation in your practice/organisation in these areas. The questionnaire will take approximately 20 minutes to complete.

Please read the instructions at the beginning of each section carefully as different questions require you to either tick (✔) or circle the answer that is most appropriate for your practice/organisation. Feel free to add any information you think may be useful, and return the completed questionnaire to myself, Judith Engelbrecht, using the pre-paid envelope enclosed. The return form below may be returned separately if anonymity is preferred. Thank you in advance for taking the time to complete this questionnaire.

November 2006

QUESTIONNAIRE RETURN FORM

(This form can be returned separately from the questionnaire if anonymity is preferred**)**

If you would like to be sent a copy of the final report of this study, please tick one of the following boxes:
Please send me a copy by email ☐ Please send me a copy by post ☐

Name:
Practice Name:
Address:

Telephone number:
Email:
Fax:
This study is part of an evolving area of research. Would you be happy to be contacted about possible further involvement in this research? Yes ☐ No ☐

Part I

Section 1. Patients

A. Practice Management Systems (PMS)

1. Please circle the answer which best indicates the extent to which patient records are computerised in your practice

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

2. If you use a Practice Management System, please tick (✔) which one you use

☐ Medtech 32 ☐ Houston GP ☐ Houston VIP

☐ Intrahealth Profile for PC ☐ Intrahealth Profile for Mac ☐ Next Generation

☐ 'Taylor Made Software' Medcen ☐ Other(s): ___________________________

3. To what extent have existing paper records been transferred to computerised form in your practice?

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

B. Patient Management and Care

1. Please tick (✔) which of the following patient management / care activities, carried out in your practice, are computerised:

☐ Patient enquiries
☐ Appointments
☐ Patient histories
☐ Documenting consultation/clinical notes
☐ Screening (e.g. BP)
☐ Managed care contracts notes (e.g. CarePlus)
☐ Decision support (use of risk assessors, alerts etc)
☐ Prescriptions writing
☐ Referrals
☐ Recalls
☐ Task list
☐ Inbox/Outbox
☐ Processing paper items/results (e.g. scanning)
☐ Accessing national registers (NHI; NIR)
☐ Obtaining Special Authorities
☐ Obtaining medical info. (e.g. travel medicine)
☐ Accessing general information
☐ Patient education (e.g. accessing leaflets)
☐ Patient communications (e.g. email; text)
☐ Staff communications
☐ Pharmacy information e.g.MIMs)
☐ Lab. results
☐ Radiology results
☐ Discharge summaries

☐ Specialist reports

☐ Checking lab. test results have been received

☐ Classifications (Read Codes)

☐ Generating letters

☐ Accessing policies and procedures

☐ Coding for care programmes (e.g. sexual health)

☐ Accessing libraries/databases (e.g. through DHB)

☐ Research projects

☐ Cold chain management

☐ Other(s): ____________________

2. Please circle the answer that best indicates the extent of use of each of the following technologies used in your practice for patient management / care

	Not used	Minimally used						Extensively used
PCs	0	1	2	3	4	5	6	7
Laptops	0	1	2	3	4	5	6	7
Palm-pilots	0	1	2	3	4	5	6	7
Cell phones	0	1	2	3	4	5	6	7
Printers	0	1	2	3	4	5	6	7
Email	0	1	2	3	4	5	6	7
Fax. Machine	0	1	2	3	4	5	6	7
Scanners (to scan documents for availability on-line)	0	1	2	3	4	5	6	7
Practice Management System (PMS) e.g. Medtech 32; Houston	0	1	2	3	4	5	6	7
Electronic results/discharge summary interface	0	1	2	3	4	5	6	7
Advanced forms	0	1	2	3	4	5	6	7
Patient dashboard	0	1	2	3	4	5	6	7
PMS briefcasing	0	1	2	3	4	5	6	7
CV risk assessment software (e.g. Predict ; Bold Promise)	0	1	2	3	4	5	6	7
Best Practice decision support system	0	1	2	3	4	5	6	7
Digital camera (For mole tracking)	0	1	2	3	4	5	6	7
ECG interfaced with PMS	0	1	2	3	4	5	6	7
Computerised Spirometer	0	1	2	3	4	5	6	7
Remote patient monitoring devices (e.g. Heart monitors; BP)	0	1	2	3	4	5	6	7
Vaccine fridge data-log software	0	1	2	3	4	5	6	7
Tympanogram interfaced with PMS	0	1	2	3	4	5	6	7
Autoclave interfaced with computer	0	1	2	3	4	5	6	7
Dictaphone for mobile nurse note keeping	0	1	2	3	4	5	6	7
Voice recognition software (e.g. Dragon Naturally Speaking)	0	1	2	3	4	5	6	7

The Internet /on-line resources (e.g. Medical websites/databases)	0	1	2	3	4	5	6	7
Electronic messaging e.g. Healthlink (Lab. results, claiming)	0	1	2	3	4	5	6	7
RSD (referrals, status reports, and discharge summaries)	0	1	2	3	4	5	6	7
Broadband Internet security system (e.g. Securit; Health Express)	0	1	2	3	4	5	6	7
Telemedicine	0	1	2	3	4	5	6	7
Remote access (e.g. from home)	0	1	2	3	4	5	6	7

Other(s): ____

Section 2. Practice Administration

A. Facility, Equipment and Supplies Management

1. Please tick (✔) which of the following activities for facility, equipment and supplies management, are computerised

☐ Purchasing
☐ Receiving IT support
☐ Maintenance organisation (buildings etc.)
☐ Liaising with PMS vendors/ service
☐ Systems back-up
☐ Systems security
☐ Other(s): ____

2. Please circle the answer that best indicates the extent of use of each of the following technologies, for facility, equipment and supplies management

	Not used	Minimally used						Extensively used
Remote access to system by PHO	0	1	2	3	4	5	6	7
Remote access to system by IT equipment vendor	0	1	2	3	4	5	6	7
Remote access to system by PMS vendor	0	1	2	3	4	5	6	7
Tapes for back-up	0	1	2	3	4	5	6	7
Duplicated disc back-up system	0	1	2	3	4	5	6	7
Anti-virus software	0	1	2	3	4	5	6	7
Firewall	0	1	2	3	4	5	6	7
Security options	0	1	2	3	4	5	6	7

Other(s): ____

B. Practice Finance and Human Resources

1. Please tick (✔) which of the following financial and human resource activities are computerised

☐ General enquiries
☐ Reception
☐ Communications
☐ Patient accounts/billing
☐ Collating data (querying)
☐ Clinical/prescribing audits
☐ Preparing reports
☐ Managed care contracts/progs. (eg. Care plus)
☐ Clinical Improvement Indicators (e.g. breast scr.)
☐ MoH reports (e.g. NIR)
☐ Healthpac claims
☐ ACC reports
☐ ACC claims
☐ DHB reports
☐ DHB claims
☐ PHO reports
☐ PHO claims

☐ Practice accounts
☐ Wages
☐ GST
☐ Banking (Internet)
☐ Staff schedule
☐ Personnel files
☐ Performance appraisals
☐ Clinical staff/locum reports
☐ Continuing medical education
☐ Contract maintenance (e.g. nursing; individ.)
☐ Checking addresses for geocoding
☐ Document maint. (e.g. payments)
☐ Practice meetings (re: ethnicities; NHI stats.)
☐ Strategic plng. (e.g. with PHO templates)
☐ Committee work
☐ Budgeting

☐ Other(s):

____

2. Please circle the answer that best indicates the extent of use of each of the following technologies for the support of financial and human resource activities

	Not used	Minimally used						Extensively used
PC	0	1	2	3	4	5	6	7
Laptop	0	1	2	3	4	5	6	7

Scanner	0 1 2 3 4 5 6 7
Fax.	0 1 2 3 4 5 6 7
Printers	0 1 2 3 4 5 6 7
PMS (MedTech 32; Houston etc.)	0 1 2 3 4 5 6 7
Financial/accounting software (not part of PMS e.g. Quicken; Cash Manager; ACE Payroll; MYOB)	0 1 2 3 4 5 6 7
PMS financial/accounting package	0 1 2 3 4 5 6 7
Electronic messaging e.g. Healthlink (Lab. results, claiming)	0 1 2 3 4 5 6 7
RSD (referrals, status reports, and discharge summaries)	0 1 2 3 4 5 6 7
Broadband Internet security system (e.g. Securit; Health Express)	0 1 2 3 4 5 6 7
Electronic reporting	0 1 2 3 4 5 6 7
Electronic report receiving	0 1 2 3 4 5 6 7
Electronic claiming	0 1 2 3 4 5 6 7
Data-mining client software from PHO (e.g. Linktech)	0 1 2 3 4 5 6 7
Remote access (e.g. from home)	0 1 2 3 4 5 6 7

Other(s):

____

Section 3. Practice Wide

1. Please tick (✔) which of the following communications technologies are used in your practice

☐ Dial-up Internet access ☐ Broadband ☐ Local Area Network (LAN)

☐ Wireless networks ☐ Fibre optic connections ☐ ISDN

☐ Microwave connections ☐ Modems ☐ CMS message access

☐ Other(s):

____

2. Please circle the answer that best indicates the extent of use of each of the following office applications/technologies in your practice

	Not used	Minimally used						Extensively used
Word processing	0	1	2	3	4	5	6	7
Spreadsheet (e.g. MS Excel)	0	1	2	3	4	5	6	7
Database (e.g. MS Access)	0	1	2	3	4	5	6	7

Desktop publishing	0	1	2	3	4	5	6	7
Project management software	0	1	2	3	4	5	6	7
Presentation software (e.g. MS Powerpoint)	0	1	2	3	4	5	6	7
Information manager (e.g.MS Outlook)	0	1	2	3	4	5	6	7
Fax. Machines	0	1	2	3	4	5	6	7
e-mail	0	1	2	3	4	5	6	7
Practice Web site	0	1	2	3	4	5	6	7
Intranet	0	1	2	3	4	5	6	7
Internet browser	0	1	2	3	4	5	6	7
Extranet access (e.g. to ACC)	0	1	2	3	4	5	6	7
Intranet access (e.g. to PHO)	0	1	2	3	4	5	6	7
Internal messaging system	0	1	2	3	4	5	6	7
Electronic bulletin boards	0	1	2	3	4	5	6	7
Remote access	0	1	2	3	4	5	6	7
CD Burner	0	1	2	3	4	5	6	7
Voice mail/answerphone	0	1	2	3	4	5	6	7

Other(s):

____

3. Please circle the answer that best indicates the extent to which computerised patient management / care and administrative systems, used in your practice, are electronically integrated (can share information/exchange data with):

i. each other (e.g. PMS and office, administration or accounting systems)?

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

ii similar systems used in your practice (e.g. PMS used by staff at remote locations)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

iii. your PHO management service's computerised information systems

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

iv. any computerised information systems in other provider practices in your PHO

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

v. any external computerised information systems (e.g. in outside organisations such as MoH, DHB, ACC, or Govt. databases, researchers, PMS vendors etc.)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

vi. to what extent are health professionals in your practice able to access all practice software programmes, which they are authorised to use, on their own computers?

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

4. Please read the following descriptions and ***tick (✔) which of the following statements best describes the present IT architecture:***

i) within your practice. *(Please tick one only)*

☐ **Discreet Manual Systems.** Our systems are manual, paper-based systems.

☐ **Discreet Computer Systems.** Our systems are run on stand alone practice computers.

☐ **Network (LAN)-Based Computer Systems.** We have several computers linked in a network, with each computer containing a different store of data. Accessing data on another computer is possible but may not be easy. Data cannot easily be combined and there is no common database.

☐ **Integrated Systems with Independent Modules.** We have several computers linked in a network, with each computer containing a different store of data. There is also a shared database e.g. the PMS, which most users can access, partly integrating the system, but the sharing of different types of data is limited (e.g. patient information and practice financial information).

☐ **Totally Integrated System.** Our systems run on a totally integrated practice network where users potentially have access to all data from any computer. There is no duplication of data and functions performed by many different individuals can all be tied together.

ii) between your practice and your PHO management service. *(Please tick one only)*

☐ **Discreet Manual Systems.** All information is exchanged using manual, paper-based systems.

☐ **Discreet Computer Systems.** Systems are run on stand alone practice, or PHO management service, computers that are not electronically linked.

- ☐ **Network (LAN)-Based Computer Systems.** We have several computers linked in a network with the PHO management service, with each computer containing a different store of data. Electronic data exchange between PHO management and practice is possible but may not be easy. Data cannot easily be combined and there is no common database.

- ☐ **Integrated Systems with Independent Modules.** We have several computers linked in a network, with each computer containing a different store of data. There is also a shared database which most users can access, partly integrating the system, but the sharing of different types of data is limited (e.g. patient information and financial information).

- ☐ **Totally Integrated System.** Our systems run on a totally integrated network where users potentially have access to all data from any computer. There is no duplication of data and functions performed by many different health professionals can all be tied together.

5. Please circle the answer that best indicates the extent to which you are satisfied that your computer systems meet practice needs:

Not at all	Minimally						Fully
0	1	2	3	4	5	6	7

<u>Part Ⅱ</u>

Section 1. Computerised Decision Support

1. *Many primary health care professionals/managers use computers to assist them in the care of their patients. The range of software available means that practices have different systems/software and 'tools' available.* ***This question explores the types of computer support used in your practice which help you make decisions when caring for your patients. Please circle the appropriate answers to the following:***

a) In this practice how much are the following systems used to acquire information to support clinical decision making?

i. Practice Management System (PMS)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

ii. Email

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

iii. The Internet

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

b) In this practice how much are the following software tools used to support clinical decision making?

i. Alerts and reminders (e.g. allergies; drug interactions)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

ii. Prescribing decision support (e.g. MIMS)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

iii. Diagnostic assistance/assessment tools (e.g. risk calculators/algorithms)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

iv. Focused evidence-based health information (e.g. Medline, Cochrane)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

v. 'Expert' opinions/systems (e.g. image recognition and interpretation)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

vi. Therapy critiquing and planning (e.g. Clinical Guidelines)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

c) To what extent do your computer systems provide the following clinical decision support features in this practice?

i. Bring information and knowledge to the point of clinical decision making (decision support delivered at the time and location of decision making)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

ii. Provide decision support automatically as part of the workflow

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

iii. Provide knowledge relevant to the particular clinical situation (e.g. for a particular patient, issue or medication) when required.

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

iv. Combine clinical knowledge with patient information to help you keep abreast of the patients health status (e.g. for prevention, intervention or follow-ups)

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

v. Identify patients lost to follow up or overdue for recommended interventions

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

vi. Alert you to contraindications or potential problems by checking planned actions against patient information and generally accepted clinical knowledge

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

vii. Provide actionable recommendations

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

d) If there are any other ways computers help to support clinical decision making in your practice, please comment in the space below.

Please give details here:

2. *In caring for their patients, health professionals/managers can face a variety of challenges in processing the wide variety of information they need e.g. various types of patient related, clinical or administrative/organisational information.* ***This question explores if new computer systems, or improved use of existing computer systems, might help them cope with these challenges. Please circle the appropriate answers.***

a) i. To what extent can you access the ***information*** you require for clinical decision making in your practice?

Not at all	Minimally						Fully
0	1	2	3	4	5	6	7

ii. In your opinion, to what extent could this ***information*** potentially be better accessed with new computer systems, or improved use of existing computer systems?

Not at all	Minimally						Very much
0	1	2	3	4	5	6	7

b) i. To what extent can you produce the ***reports*** you need to in your practice?

Not at all	Minimally						Fully
0	1	2	3	4	5	6	7

ii. In your opinion, to what extent could these ***reports*** potentially be better provided using new computer systems, or improved use of existing computer systems?

Not at all	Minimally						Very much
0	1	2	3	4	5	6	7

c) i. To what extent ***have you unmet information/information processing needs*** in your practice?

Not at all	Minimally						Very much
0	1	2	3	4	5	6	7

ii. In your opinion, to what extent could your ***unmet information needs*** potentially be better satisfied using new computer systems, or improved use of existing computer systems?

Not at all	Minimally						Very much
0	1	2	3	4	5	6	7

iii. If you have ***unmet information needs***, please list them in the space below:

3. *Health professionals/managers have joined together in Primary Health Organisations (PHOs) and there are new requirements for the processing of information used in decision making for patient care.* ***This question looks at how PHO membership has impacted the use of computers in the support of decision making for patient care in your practice. Please circle the appropriate answers.***

a) To what extent has PHO membership resulted in your practice changing its computer hardware?

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

b) To what extent has PHO membership resulted in your practice changing its computer software?

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

c) Since joining the PHO has your practice received assistance with any changes you have made (e.g. technical or financial, from the PHO)?

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

d) Since joining the PHO has your practice needed to do more data collection /reporting?

Not at all	Minimally						Much more
0	1	2	3	4	5	6	7

e) Since joining the PHO has your practice been able to fulfill its information processing needs using its computer systems?

Not at all	Minimally						Fully
0	1	2	3	4	5	6	7

f) Has PHO membership helped in the reduction of barriers to the use of computers in the support of clinical decision making in the practice?

Not at all	Minimally						Extensively
0	1	2	3	4	5	6	7

g) Since joining the PHO does your practice received more information which supports clinical decision making in the practice?

Not at all	Minimally						Much more
0	1	2	3	4	5	6	7

Please give details here:

h) How does your practice receive information which is useful in decision making for the care of its patients /patient population *(Please circle the appropriate answers)*

i) from your ***PHO management service?***

	Not at all	Hardly ever						Mostly
Secure messaging e.g Healthlink	0	1	2	3	4	5	6	7
E-mail	0	1	2	3	4	5	6	7
Fax.	0	1	2	3	4	5	6	7
Post	0	1	2	3	4	5	6	7
Telephone	0	1	2	3	4	5	6	7
Face-to-face	0	1	2	3	4	5	6	7
Other	0	1	2	3	4	5	6	7

ii) from ***other practices/providers?***

	Not at all	Hardly ever						Mostly
Secure messaging e.g Healthlink	0	1	2	3	4	5	6	7
E-mail	0	1	2	3	4	5	6	7
Fax.	0	1	2	3	4	5	6	7
Post	0	1	2	3	4	5	6	7
Telephone	0	1	2	3	4	5	6	7
Face-to-face	0	1	2	3	4	5	6	7
Other	0	1	2	3	4	5	6	7

4. *Barriers to the use of clinical decision support software/tools have been identified in health care literature.* ***This question asks you to what extent there are potential barriers in the following areas, to your improved use of computer systems for the support of clinical decision making in your practice. Please circle the appropriate answers:***

	Not at all	Minimally						Very much
Cost	0	1	2	3	4	5	6	7
Hardware	0	1	2	3	4	5	6	7
System speed	0	1	2	3	4	5	6	7
Software (in general)	0	1	2	3	4	5	6	7
Format (appearance)	0	1	2	3	4	5	6	7
Functionality	0	1	2	3	4	5	6	7
Content (order, level of detail)	0	1	2	3	4	5	6	7
Flexibility/ease of adjustment	0	1	2	3	4	5	6	7
Credibility of information (who is responsible for the decision?)	0	1	2	3	4	5	6	7

Training	0 1 2 3 4 5 6 7
Knowledge of appropriate systems/tools	0 1 2 3 4 5 6 7
Skills/degree of comfort using clinical decision support progs.	0 1 2 3 4 5 6 7
Ability to fully utilise PMS features	0 1 2 3 4 5 6 7
On-going systems support	0 1 2 3 4 5 6 7
Time (workload)	0 1 2 3 4 5 6 7
Security	0 1 2 3 4 5 6 7
Privacy	0 1 2 3 4 5 6 7
Computers being intrusive during consultations	0 1 2 3 4 5 6 7
Reading material on the screen	0 1 2 3 4 5 6 7
Typing ability	0 1 2 3 4 5 6 7
Staff resistance	0 1 2 3 4 5 6 7

If there are any other barriers, please comment below:

Please give details here:

Section 2. General Information

(Please tick (✔) the appropriate boxes)

1. About the Respondent

a) Age group: <30 ☐ 30-45 ☐ >45 ☐

b) Gender M ☐ F ☐

c) Please indicate your field of specialisation, experience or training

☐ Medicine ☐ Nursing ☐ Administration/Health Management

☐ Information Technology ☐ Other : ____________________

d) Title: ____________________

e) Experience in current function: ________________ (months/years)

f) Experience in current organisation: ________________ (months/years)

g) Duration of courses taken in IT________________ (months/years)

h) Length of experience in the use and/or management of IT : _______ (months/years)

i) How long have you used a computer regularly (work and home)?__ (months/years)

j) How long have you used a PMS (e.g. MedTech)? (if applicable) ___ (months/years)

k) Who/what influenced you to start using a PMS______________________________

2. About the Practice

a) Name of Practice: ____

b) % of annual budget spent on IT _______________% (approx.)

c) Annual IT budget for the current year is $ ________________ (approx.)

d) Does the practice have an IT disaster recovery plan (backup systems etc.) __(Y/N)

e) Does the practice have an IT future plan (strategic plan) __________(Y/N)

f) Does the practice have a security plan?__________(Y/N)

g) Total number of staff: _________

h) Number of Doctors (FTE): _________

i) Number of Practice Nurses (FTE): _________

j) Number of other Health Professionals: _________

k) Number of administrators (FTE): _________

l) Number of internal IT staff (FTE) _________

m) Number of external IT consultants_________

n) How long has this practice used a computer regularly? __________ (months/years)

o) How long has this practice used a PMS regularly? _____________ (months/years)

p) Who/what influenced this practice to start using a PMS?_____________________

If there is there anything else you would like to add to this questionnaire please comment below:

Thank you for contributing to this survey, your help is very much appreciated!

10.4 Appendix 4: Additional results

10.4.1 PHO-MS interview findings

Table 10.2: Technologies supporting one or more PHO-MS

		Combined PHO-MS technologies: Pilot (PHO 1); PHO 2; PHO 3
Technologies	Admin.	• PCs/Desktop computers • Laptop computers • Windows software • MS office: Word; Excel; Powerpoint; Outlook • Spread sheets • Adobe Dreamweaver for the website • Photoshop • Acrobat • Choral draw desktop publishing (for certificates, leaflets, reports etc.) • PMSs e.g. Medtech32 • email • Electronic agendas • Cell 'phone – used for email; Internet access; appointments etc. • Storage devices: CDs Floppy discs Flash discs Tapes • Servers • Private messaging system. • Fibre optics • Microwave connections • Virtual private network (VPN) • Securit connections (HealthLink) • Networks: LANs; WAN (or MAN – Metropolitan Area Network); Connections to MoH via the Internet • Wireless capability • Remote access • Basic office network (MS Windows based) • MS Small Business Server • Accounting system • Broadband • Building security alarms • Individual staff log-ins. • Anti-virus controls. • Firewalls • The Internet • Intranet (or in development) • Small database for share registry / Contract lists • Web hosted quality system (operational procedures and policies) – currently being developed. • Web hosted service to manage contracts and business plan activities. Will become more essential in the next couple of months (for referred services contracts e.g. Pharmacist's analyses) • Teleconferencing • Vaccine fridge software
	Population/ Patient managmnt.	• PCs • Laptop • Fax.

		• PMS systems: Houston VIP; Medtech 32; Profile • MS office: Word; Excel; Powerpoint; Outlook • Publisher • Spreadsheets • email • Remote access • Mobile phone • The Internet • Intranet (or in development) • HealthLink • Medtech's Linktech (being implemented) • Advanced forms (Medtech) • i Tools (for project management) • Fridge loggers • Electronic whiteboard • Nurses dictaphone • Forms and templates for diabetes • CDs • Flash drives • Broadband • Website (or in development) • Access to DHB intranet • Palm pilot
	Population/ Patient care	• PCs • Laptops • Fax. • Printer • Scanners • Medtech 32 • Medtech briefcasing • Knowledge base (in Medtech 32) • MS office: Word; Excel; Powerpoint • Outlook (with calendar/appointment diary linked to cellphone) • Internal email • Broadband • Internet browser (Explorer) • Internet • Intranet • HealthLink • Cellphone • Dictaphone • Electronic whiteboard • Mango (for medical image viewing) • iTools (research/referencing tool) • Remote access (from home) • Travel medicine software • Microwave system (private v. commercial system) • DHB medical library access • National datasets • Linktech • Advanced forms
Organisation wide technologies	Connectivity	• Fax. machines • Broadband • Modems • LANs • WANs • HealthLink (Secure messaging/VPN) • Securit (HealthLink Internet security) • Fibre optics • Wireless networks: Microwave; Infrared; Satellite connections • CDs
	Office automation	• Word processing • MS Exchange for email

		• Telecom One Office – a network which allows users to connect to office network from home. • Spreadsheets • Desktop publishing • Project management software. • iTools web based project/performance management software • Electronic agenda (Diary) • Intranet discussion groups • Electronic whiteboard • Electronic agenda (extended facility for being mobile – part of MS Exchange. Allows email and calendar to be kept on a mobile phone) • USB keys • Interactive voice messaging
	Internet-based applications	• The Internet • VPN (non-commercial) • Website (or in development) • Intranet with remote access for all staff from home, for Intranet and email (or in development). • Extranet (in development for GP access) • Internal email system • External email system • Electronic bulletin board (or part of new website development)
IT Architecture (PHO-MS self assessment)		**Within PHO-MSO:** **PHO 1 -** LAN based automated systems (level 3). **PHO 2 -** Totally integrated system (level 5) – {Discreet manual systems (level 1) with DHB); Totally integrated systems (level 5) with labs. and radiology}. **PHO 3 -** Network (LAN) - based computer systems (level 3), and integrated systems with independent modules (level 4). **Between PHO-MSO and PHPs (member practices):** **PHO 1 -** Discrete automated systems (2) ("… potentially at level 3" - *IT co-ordinator*) **PHO 2 -**Discreet manual systems (level 1), discreet automated systems (level 2), and network (LAN) - based automated systems (level 3). **PHO 3 -** Discreet manual systems (level 1)

10.5 Appendix 5: Published and additional pilot study findings

The pilot study contributed to the development of the questionnaire survey tool, and information on the use of computerised technologies for CDS throughout the pilot study organisation. Data collected from the interviews, and postal survey of GP practices in the pilot PHO, was analysed and indicated the wide range of usage of technologies for CDS by those practices, and a number of barriers to their better utilisation. A sample of pilot study results are presented below including findings which resulted in refereed journal publications (Engelbrecht et al., 2006, 2007a, 2007b).

Respondents were provided with instructions on how answers to each question should be given. Questions were designed using the following:

- Linear numeric scales of 1-7 where 1 equals ‘Not at all’, and 7 equals ‘Very much’;
- A Linear numeric scales of 1-7 where 1 equals ‘Hardly ever’ and 7 equals ‘Mostly’;
- Tick boxes offering various options, or
- Clear spaces for unstructured answers.

For questions which were designed using a linear numeric scale, respondents were asked to rate their response on the scale and were also given a ‘Not applicable’ (0=N/A) choice. Blank and N/A responses were treated as missing data. For ease of description results have sometimes been combined to group the responses into a weak response (rating of 2 and 3), a moderate response (rating of 4 and 5), or a strong/‘Very much’ response (rating 6 and 7). Responding practice demographics are shown in Table 10.3:

Table 10.3: Pilot case (PHO 1) GP practice demographics

Pilot case (PHO 1) GP practices (n=10)	
Respondents role	60% Doctors; 40% Administrators
Average number of staff	6.5 (3-21)
Average number of doctors (FTE)	1.8 (1-5)
Average number of nurses (FTE)	1.9 (1-4)
Average number of administrators	2.0 (1-8)
Average number of internal IT staff	0.1 (1)
Average years of regular PMS use	7.2 (1-13)
% with IT back-up system	80% Yes; 10% No

10.5.1 Question area 1: Computerised CDS

The following questions focused on practice technology infrastructure, and the use of IS in the support of CDM.

10.5.1.1 Practice technology infrastructure

Table 10.4 shows the range of technologies used in the support of patient care by 30 percent or more of practices responding to the questionnaire. PMSs, fax machines, printers, PCs, HealthLink[7] connections, and word processing software were used by 100 percent of the practices. The Internet/external websites or databases were used by 90 percent, and email by 80 percent. However, some technologies such as laptops and risk assessment software were only used by 30 percent of the practices.

Table 10.4: Pilot study GP practice use of technologies

Technology	% Practices using technology	Technology	% Practices using technology
Practice Management Systems (PMS)	100	Desktop publishing	70
Fax. Machine	100	Server	60
Printer	100	Secure file transfer (eg, Securit)	60
PCs	100	Scanner	50
HealthLink connection	100	Cell-phone	50
Word processing software	100	Information manager (eg, Outlook)	40
The Internet/external websites or databases	90	Remote access	40
Internal messaging system	90	Intranet application	30
Spreadsheet	90	Laptop	30
Extranet application (eg, ACC logging)	80	Digital camera (for mole tracking)	30
Email	80	AI/expert systems (eg, risk assessor)	30

Figure 10.8 illustrates the practice sizes and the percentage of the technologies which are listed in Table 10.4 that are used by each respondent practice. The individual practice use of these technologies varied between 45.5 percent and 95.5 percent, with all but the smallest practices using more than 50 percent of them, and there appeared to be little evidence that increasing practice size corresponded to increased technology infrastructure.

[7] Secure network for health sector electronic messaging

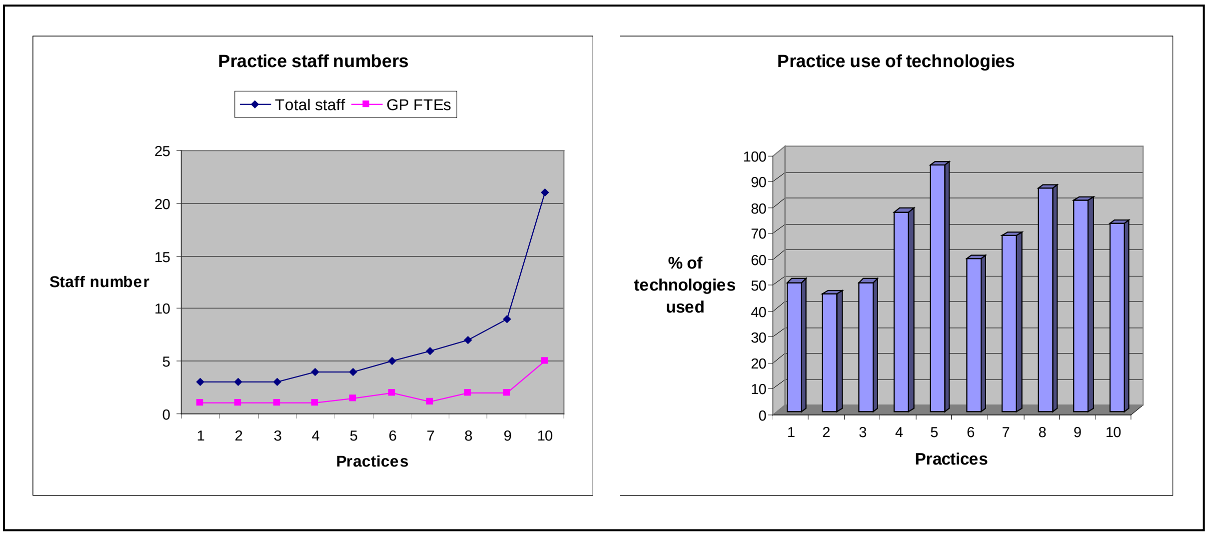

Figure 10.8: Practice size and corresponding percentage of technologies available in individual pilot study GP practices [8]

10.5.1.2 The use of popular systems

Figure 10.9 shows that PMSs, the Internet/external websites or databases, and email were used by 100 percent, 90 percent and 80 percent of practices respectively. However, when asked about their use of these systems specifically in the support of CDM when caring for their patients, the percentage of practices found to use the systems in that way was smaller, being 60 percent, 70 percent and 30 percent respectively.

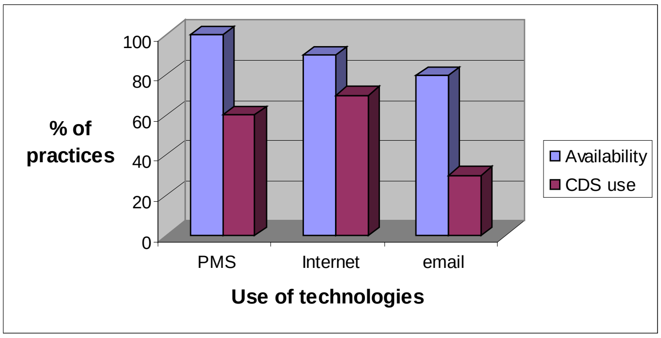

Figure 10.9: Practice use of three technologies in pilot study PHO

A qualitative analysis of the interview data revealed some of the reasons for this lack of use of available IT for CDS. For example, one practitioner interviewed does not use the PMS for clinical notes, but does use alerts and reminders for drug interactions, cervical

[8] Practices 1-3 are the same size, based on the total number of staff and GP FTEs in each practice.

smear recalls and vaccination notices. The same practitioner does not use email or the Internet and cited security as a main concern.

Similarly, a practice nurse at another practice also uses alerts and reminders contained within the PMS, but indicated that user skills could influence system utilisation:

> "It's got the capability to do that [provide alerts and reminders]. It's only as good as the operator…We all do our own [setting up]….I use it a lot, especially for over-dues."

In some cases, access issues for some members of a primary care team can result in under-use of a facility. For example, the same nurse would use the Internet more if given ready access:

> "I can gather [needed information] but I have to go outside of work to do it…you see [the doctor's] got the Internet for "travel" which he looks up and…I have a lot of queries about travel and I have to go to him for that because I can't directly access it myself …"

In other cases personal preferences result in widely varying use by different people in the same practice. A doctor at one practice does not use the Internet much and does not use email at all for CDS, whereas, in the words of an administrator in the same practice:

> "Our doctors do use that [email] quite a lot: for special authorities - if they've sent one away and they haven't got it back; for ACC, if they have a lot of clients who come in and say "ACC declined my claim. What do I do now…?" We have a lot of interaction with WINZ,[9] because a lot of our clients are beneficiaries, so we have a lot to do with working with the case managers…"

Survey subjects were also asked to rate how much, if at all, their PMS, The Internet, and email were used in the support of CDM when caring for their patients. One third of respondents reported that they used their PMS 'Very much' (7) whilst another third answered 'Not at all' (1) with the remaining respondents divided equally between a weak response (2), a moderate response (5), and the strong response (6). 30% of subjects did not use the Internet at all (1) for CDM support, whilst 20% reported using it 'Very much' (7), 30% reporting a weak response (2 and 3), and a further 20% a moderate response (4 and 5). Email results were less well distributed with 62.5% reporting that it is used 'Not at all' (1) for CDM support, with 25% giving a weak response (2) and only 12.5% giving a moderate response (5). See Figure 10.10.

[9] Work and Income New Zealand

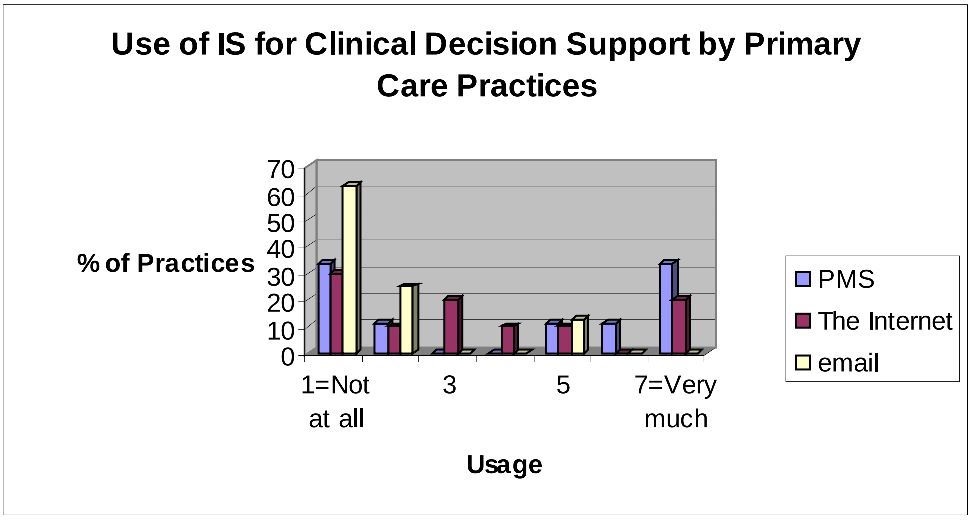

Figure 10.10: Percentage of pilot study practices using popular IS for CDS

A graph of the usage of the three systems relative to practice size shows that the use of email in the support for CDM tended to be reported only by larger practices, whilst a lack of use of any or all three systems was more common in the smaller practices. 80% of practices reported some use of one or more of the systems for CDS with 30% using email, 60% using PMSs and 70% using The Internet. See Figure 10.11. The space provided for unstructured answers was left blank by 100% of respondents.

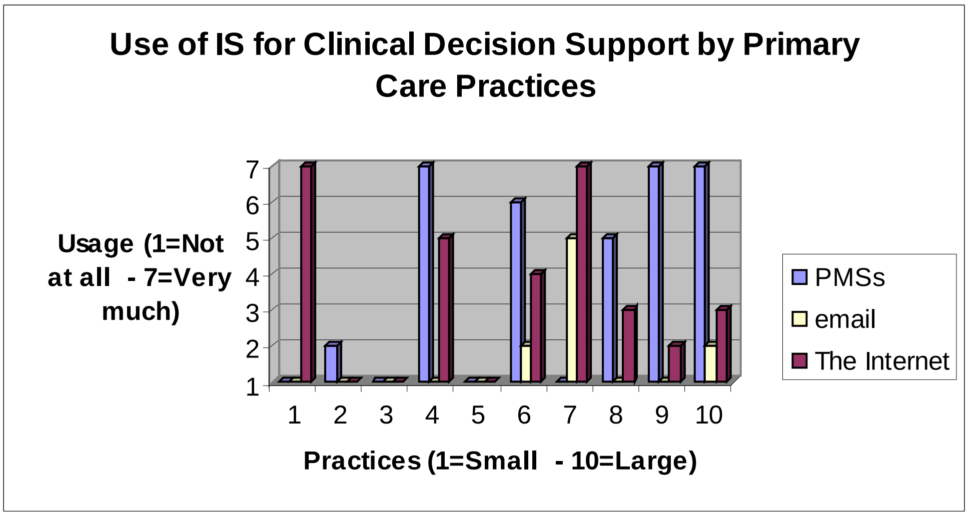

Figure 10.11: Usage of popular IS for CDS by pilot study practices

10.5.1.3 The use of CDS tools

Another question asked how much, if at all, the following software 'tools' are used to support CDM when caring for their patients: Alerts and reminders (e.g. for allergies or drug interactions); diagnostic tools (e.g. algorithms); focused evidence-based health information (e.g. Medline, Cochrane) and 'expert opinions' (e.g. MIMS). Alerts and reminders scored highly with two thirds of respondents rating their use with a strong/'Very much' response (6 and 7), no respondent reported not using them at all. 22.2% rated their usage as weak (2), with 11.1% as moderate (4). The use of diagnostic tools, varied greatly with scores of 'Not at all' (1) by 50% of practices with 16.7% using them 'Very much' (7), and the remaining third recording a moderate response (4 and 5). Focused evidence-based information also had a high negative response with 42.9% reporting 'Not at all' (1), 28.6% giving a weak score (2), with 14.3% giving a moderate score (5) and the remaining 14.3% rating their use as 'Very much' (7). 'expert opinions' were used 'Very much' (7) by 37.5% of respondents, with a further 12.5% also recording a strong response (6). 25% gave a moderate response (5), with 12.5% responding weakly (3), and 12.5% reporting their use as 'Not at all' (1). See Figure 10.12.

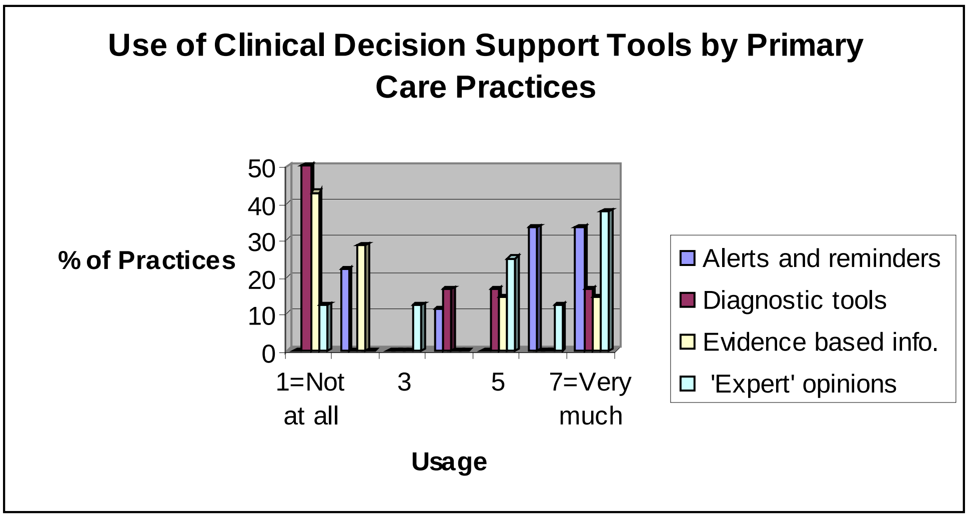

Figure 10.12: Percentage of pilot study GP practices using popular CDS tools

The space provided for unstructured answers was left blank by 90% of respondents. One respondent commented "Roche: Assessment of Creatinine Clearance – '2' occasional"

10.5.1.4 The use of CDS features

Table 10.5 presents the results from the third question which asked respondents to what extent their computer systems provide certain types of support for clinical decision making. Seven CDS features are listed in the first column of the table (A-G). The percentage of practices responding 'Not at all', 'weak', 'moderate' and 'strong/Very much', are recorded in the second, third, fourth and fifth columns respectively. Features A B, C and E were reportedly provided to some extent by practice systems at all responding practices, whereas Features D, F and G were not provided at all in a small percentage of practices (12.5%, 14.3% and 12.5% respectively). All features scored weakly with between 42.9% and 62.5% of practices with the exception of Feature A, ‘Identify patients lost to follow up or overdue for recommended interventions’, which was rated weakly by 22.2% of practices, moderately by 55.6% and strong/’Very much’ by 22.2%. Moderate responses were recorded for all except Feature A by between 12.5% and 28.6% of practices, and responses of strong/very much recorded for all features by between 12.5% and 37.5% of practices, with Feature B, ‘Combine knowledge with patient information to help in keeping abreast of the patients health status’ rating in the highest category with the largest percentage of practices.

Table 10.5: The extent pilot study respondents consider their practice IS provide CDS features

Clinical decision support features	% Response - ‘Not at all’ (1)	% Response - Weak (2, 3)	% Response - Moderate (4, 5)	% Response - Strong/ ‘ V. much’ (6, 7)
A. Identify patients lost to follow up or overdue for recommended interventions	0	22.2	55.6	22.2
B. Combine knowledge with patient information to help in keeping abreast of the patients health status	0	50.0	12.5	37.5
C. Provide knowledge relevant to the particular clinical situation	0	50.0	25.0	25.0
D. Provide decision support automatically as part of the workflow*	14.3	42.9	28.6	14.3
E. Alert one to contraindications or potential problems by checking planned actions against patient information and generally accepted clinical knowledge	0	62.5	25.0	12.5
F. Bring information to the point of clinical decision making*	12.5	50.0	12.5	25.0
G. Provide actionable recommendations*	12.5	50.0	25.0	12.5

* see Section 7.3.1.3.

The space provided for answers to a question asking if there were other ways computers help to support their clinical decision making, was left blank by 100% of respondents.

10.5.2 Question area 2: Information processing requirements

This question explored the ability for practices to gather required information and produce needed reports, and the extent to which practices have unmet information/information processing needs, for CDM. In each case it also asked to what extent could new or improved existing computer systems potentially better serve these requirements. Figures 10.13, 10.14, and 10.15, and Table 10.6 illustrate the results.

10.5.2.1 Information gathering

The ability for practices to gather required information varied between a weak response (2 and 3) from a third of the respondents, a moderate one (5) from 22.2% and a strong/'Very much' (6 and 7) response from 44.4%. The potential for new or improved IS to help in information gathering was perceived as 'Not at all' (1) by 11.1%, weak (2) by 22.2%, and was equally perceived as moderate (4 and 5) or strong/'Very much'(6 and 7) by 33.3% in each case. See Figure 10.13.

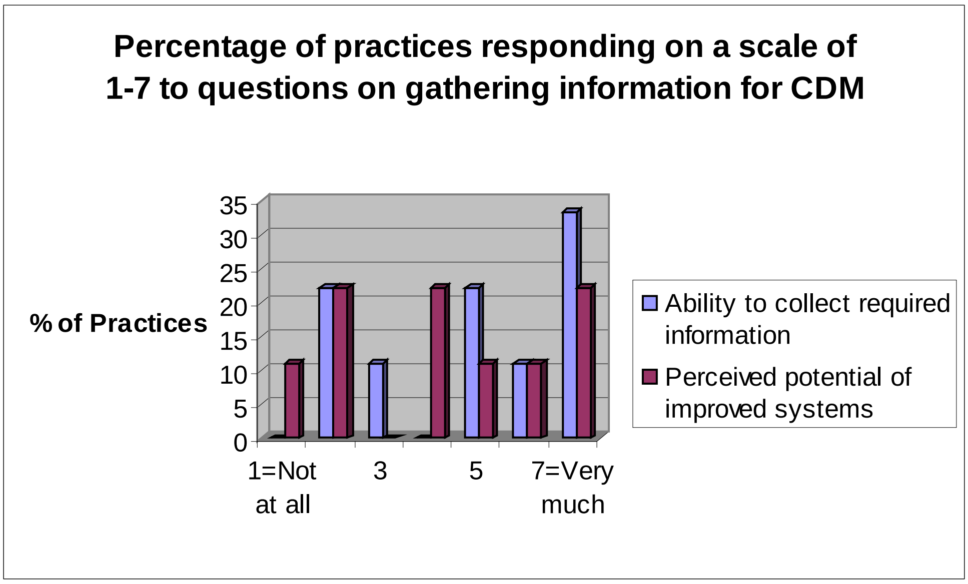

Figure 10.13: Pilot study GP practice responses to questions on information gathering needs

10.5.2.2 Reporting

When asked if they could produce needed reports in their practice 11.1% of respondents recorded 'Not at all' (1), 11.1% reported a weak response (3), with moderate (4 and 5) by 44.4%, and strong/'Very much' (6 and 7) by 33.3% of respondents. The perceived benefits from the use of new or improved systems were reported as weak (2) and strong/'Very much' (6 and 7) by 37.5% in both cases, with 12.5% recording a moderate rating (4), and 12.5% reporting "Not at all' (1). See Figure 10.14.

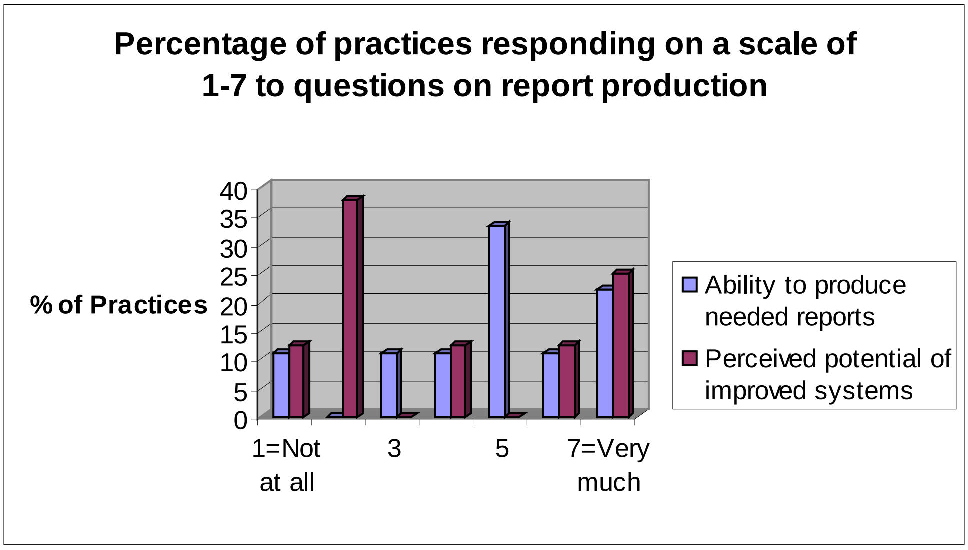

Figure 10.14: Pilot study GP practice responses to questions on report preparation

10.5.2.3 Information processing needs/data issues

The extent of unmet information/information processing needs in their practices were rated as 'not at all' (1) by 33.3% of respondents, with 44.4% recording a weak extent (2 and 3), and 11.1% for each of the moderate (4) and strong (6) ratings. However, when asked their opinion as to what extent could their unmet information needs potentially be better provided using new or improved existing computer systems, 57.1% reported a strong/'Very much' rating (6 and 7), 28.6% reported a weak rating (1), 14.3% recorded 'Not at all' (1), and no respondent gave a moderate rating. See Figure 10.15. Unmet information needs stated by respondents in an unstructured answer area are presented in Table 10.6.

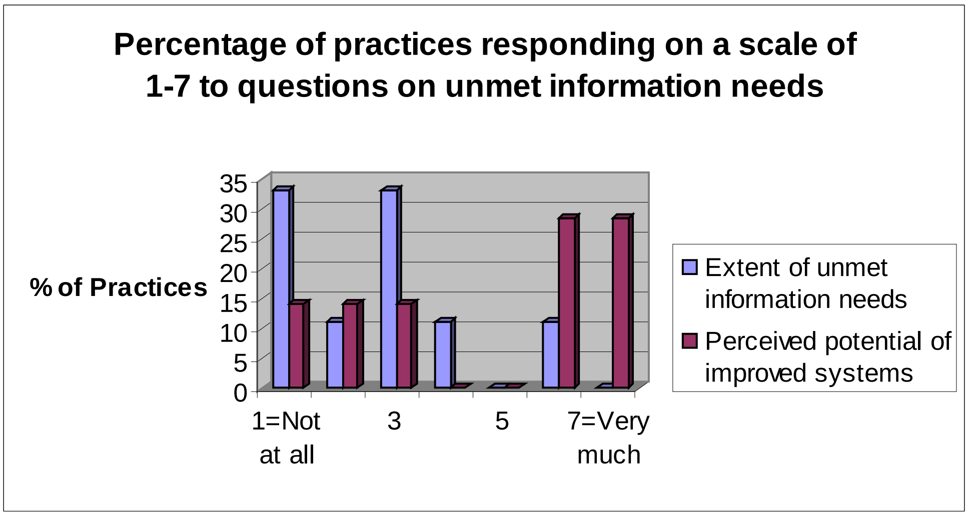

Figure 10.15: Pilot study GP practice responses to questions on unmet information needs

Table 10.6: Pilot study GP practice unmet information needs

A sample of PHO 1 unmet information needs
"We do not have access to the advanced screening tabs on Medtech and it would be very costly for a sole GP to obtain these"
"We have a very sophisticated query builder (report writer) but we have not computerised our disease register which limits the information we can get out".
"ACC 'stuff' e.g. accident details, numbers etc. Checking claims for variance reports".
"A person for support…….explaining in easy terms……….".
"Linking seamlessly to algorithms (e.g. NZGG) via PMS"

10.5.3 Question area 3: PHO impacts

This survey question explored how PHO membership had impacted the practices. Table 10.7 shows that the practices reported positively that they were able to fulfil their information processing needs, with all giving moderate to strong scores. However, this was achieved against challenges presented by increased reporting and information gathering needs indicated by the second and third strongest responses, where 88.0% and 77.0% of practices respectively, gave high scores between 4 and 7. Receipt of assistance for changes from the PHO was considered moderate by 55% of practices. The need for increased electronic storage facilities, or for changes to be made to hardware or software rated lower than the other items, with 11-15% of practices answering that they had no need for these changes. Table 10.8 illustrates the relative importance of communications media by which practices receive information useful for CDM from their PHO-MS and from other member practices. Secure messaging (e.g. HealthLink) was reported as the most important method of communication from the PHO-MS with an average score of 4.5, but was less important for communications from other member practices as indicated by its ranking as fourth in importance. Otherwise, traditional modes of communication were favoured from both management and other practices, with low scores for email of 1.5 and 1.3 respectively.

Table 10.7: Pilot study GP practice experiences since joining their PHO

	% Response - 'Not at all' (1)	**% Response - Weak (2, 3)**	**% Response - Moderate (4, 5)**	**% Response - Strong/ 'V. Much' (6, 7)**
Ability to fulfil information processing needs	0	0	3.3	6.7
Increased reporting needs	0	1.1	4.4	4.4

Increased information gathering needs	0	2.2	3.3	4.4
Receive assistance regarding changes	0	2.2	5.5	2.2
Increased electronic storage needs	1.1	3.3	2.2	3.4
Changes in computer hardware	3	2	1	4
Changes in computer software	5	2	0	3

Table 10.8: Relative importance to pilot study GP practices of communication modes

Extent of communications by different methods from PHO-MS:	**Scale=1- 7 (Hardly ever - Mostly)**
Secure messaging e.g HealthLink	4.5
Telephone	4.3
Fax.	4.1
Post	4.0
Face-to-face	3.3
E-mail	1.5
Other means	0.8
Extent of communications by different methods from other practices/providers in the PHO:	
Post	5.1
Telephone	4.3
Fax.	4.1
Secure messaging e.g HealthLink	3.1
Face-to-face	1.4
E-mail	1.3
Other means	0.9

10.5.4 Question area 4: Barriers

The last question probes the extent of perceived barriers to the improved use of computer systems for the support of CDM by primary care practices. Table 10.9 presents the percentage of practices rating potential barriers at each rating level. The majority of respondents (88.9%) reported a moderate or strong/'Very much' rating for both cost and time as barriers, with 11.1% not considering them a barrier at all. Training was seen by 77.7% of practices to rate as moderate or strong/'Very much', with it not being an issue for 22.2% of practices. Skills in using CDS programmes and credibility were rated as moderate or strong/'Very much' by 75% of respondents, with 12.5% reporting them as no barrier, whilst security was rated highly by 55.5%, with 22.2% reporting it as no barrier. 55.5% recorded software as rating 'moderate' or 'strong/'Very much'' as a barrier, with 44.4% having the view that it was 'Not at all'.

Flexibility/ease of adjustment and privacy were rated as moderate or strong/'Very much' by 55.5% of practices, with one third reporting them, in each case, as no barrier. 'On-going system support', and 'knowledge of appropriate systems/tools', were similarly rated with 55.5% rating them as moderate or strong/'Very much', but with a higher percentage of practices (44.4%) reporting the former as no barrier, and 11.1% rating the latter in the same way. One third of respondents gave knowledge of appropriate systems/tools a weak rating. Hardware rated as a weak or moderate barrier with two thirds of practices, with 22.2% not considering it a barrier, whilst software was rated as both a moderate and no barrier at all, in each case by 44.4% of respondents. 'System speed' ratings were fairly equally distributed with each one third of practices recording it as no barrier, a weak barrier or a moderate-strong/'Very much'. Content, functionality, and format were rated by 33.3%, 44.4 and 55.6% of practice respondents, respectively, as not being a barrier, and each were rated by 11.1% at the strong/'Very much' level, with the balance of responses resting in the weak and moderate range.

When given a space to answer freely if there are any other barriers, 90% left the comment area blank, with one respondent reiterating, as follows, the importance of two barriers to which they had already assigned scores of 7 ('Very much'):

> "Security of information is a very big issue, as is Privacy. We will need LOTS of information/reassurance before we are happy to integrate our systems further I don't believe in Chinese walls. The NZ public needs to be part of this discussion".

Table 10.9: Perceived importance to pilot study GP practices of barriers to their improved use of IS to support CDM

Potential Barrier	**% Practices Rating 'Not at all' (1)**	**% Practices Rating Low (2, 3)**	**% Practices Rating Moderate (4, 5)**	**% Practices Rating Strong/ 'V. much' (6, 7)**
Time	11.1	0	33.3	55.6
Cost	11.1	0	55.6	33.3
Training	22.2	0	44.4	33.3
Credibility	12.5	12.5	25	50
Skills in using CDS programmes	12.5	12.5	37.5	37.5
Knowledge of appropriate systems/tools	11.1	33.3	22.2	33.3
Security	22.2	22.2	44.4	11.1
Privacy	33.3	11.1	33.3	22.2
Flexibility/ease of	33.3	11.1	33.3	22.2

adjustment				
On-going system support	44.4	0	22.2	33.3
Software	44.4	0	44.4	11.1
Hardware	22.2	33.3	33.3	11.1
Content (type, level of detail)	33.3	22.2	33.3	11.1
Functionality	44.4	11.1	33.3	11.1
System speed	33.3	33.3	22.2	11.1
Format (appearance)	55.6	22.2	11.1	11.1