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Critical success factors for electronic medical records access by primary health care professionals

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Abstract

Electronic medical records (EMRs) are increasingly used in health care. Their successful use will result in improving the efficient integration of primary and secondary care, one of the main strategies of the current health reforms in New Zealand. Some secondary health care institutions in New Zealand are considering implementing an EMR that will be located within the secondary health care institution but that could be accessed by primary health care professionals.

The purpose of this research project was to identify the critical success factors for access by primary health care professionals, who may not be employees of the secondary health care institution, to such an EMR.

The research project utilised a variety of data collection methodologies. A literature review identified published primary and secondary health care requirements. A postal survey of GPs, midwives and specialist obstetricians working in primary care within a Crown Health Enterprise (CHE) catchment area was conducted. The literature review enabled the development of a critical success model based on the Technology Acceptance Model which was supported by the results of the primary care survey.

The findings of this research project indicate that critical success factors for EMR access include user acceptance of the EMR, perceived usefulness of an EMR that is easy to use, ensuring privacy, security and confidentiality of data, obtaining patient consent, and the use of data and communication standards. The concerns of all the users of an EMR have a significant impact on the success of an EMR system implementation in a secondary care health care institution that can be accessed by primary care health professionals. If these concerns are not met, use of the system will be limited, the benefits of such a system will not materialise and the implementation project will not be successful.

This research project recommends that further research is undertaken to explore the concerns of patients regarding the access to and use of EMRs.

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Chapter 1 - Introduction

Increased efficient integration of primary and secondary care is one of the main strategies of the current health reforms in New Zealand. Improved communication and information flow has a major part to play in this integration. Electronic transfer systems, involving computer linkages between providers, with a common data base, are one means to this improved integration between primary care and secondary care. A secondary health care provider in New Zealand is considering such a use of an electronic transfer system, in the form of an electronic medical record (EMR). They are investigating the role that primary health care providers, such as general practitioners, should take with interfacing with this EMR.

Thus, the purpose of this research project is to identify the critical success factors for access to an electronic medical record system held within a secondary health care institution by primary health care professionals, who may not be employees of that secondary health care institution. This research project was funded by the Foundation for Research, Science and Technology.

A literature review of primary health care computing focused on end-user computing and GP computing. There was little published literature relating to the use of EMRs by GPs. Whilst there is an increasing trend towards computerisation of general practices, many GPs remain apprehensive about and reluctant to use computers for much more than financial and administrative tasks. They remain unconvinced about the benefits of EMRs, have severe reservations about the privacy, confidentiality and security of data within the EMR and consider that cost (both financial and time) is a significant barrier to computerisation in general.

There is a wide range of self-reported computer experience amongst GPs and user support and training is a high prerequisite for successful use of computers in general practice. GPs are reluctant to change their work behaviours without good reason, especially from the tried and tested manual clinical record systems, and resist change being imposed on them from others. GP representation in the implementation of an EMR is recommended by many researchers in this field.

However, GPs are concerned about the problems with information transfer between primary and secondary care and are keen to improve this integration of patient care. Many problems between primary and secondary care relate to lack of timely and accurate patient information, including up-to-date demographics, and the delay in the transmission of patient inpatient and outpatient details from secondary care back into primary care. The introduction of Independent Practitioner Associations (IPAs) into the New Zealand primary health care arena has increased the awareness and need for general practice to be computerised and is a 'push' towards increasing the electronic transfer of data between the GPs, the IPAs and the Regional Health Authorities (or their replacements). This has raised issues of information ownership, remuneration for the provision of information by GPs to other health agencies, and who has the right to request what information from whom about which patient events.

A primary care survey was conducted as part of this research project, the results of which indicate that these concerns are important to all primary healthcare professionals, not just GPs. In particular, user acceptance of the EMR was seen as a major factor in the use of an EMR. A major area of concern for the successful use of an EMR was that, due to the concerns regarding privacy, security and confidentiality, only limited information would be transferred by primary healthcare professionals to the EMR. Patient consent was also highlighted as an essential pre-requisite for transferring information to an EMR.

The use of EMRs within secondary care is slowly increasing, mainly in the USA. Plans to introduce a National Health Service (NHS)-wide EMR in the United Kingdom are deferred until concerns relating to security, privacy and confidentiality raised by GPs have been adequately addressed. The main problems with the introduction of EMRs within the USA, and across Europe, is the lack of standards within the industry as a whole, both in terms of data and in communications. Australia is keen to implement EMRs but seems to be looking at events in New Zealand, USA and Europe before committing itself to the widespread adoption of EMRs. Within New Zealand, few Crown Health Enterprises (CHEs) share data electronically with other organisations, despite all

using computers for many of the financial and administrative functions, and very few CHEs use EMRs. However, most CHEs, believe that the use of EMRs and electronic data sharing will increase markedly in the future. Patient consent, privacy, security, and confidentiality of data and access controls were major areas of concern regarding the use of EMRs within secondary care.

A further barrier to the increased adoption of EMRs, both in primary care and secondary care, is the lack of national and regional direction, co-ordination, planning and advice and the lack of the provision of the required infrastructure including the policies, standards, networks and communications.

In summary, this research project reports the results of an investigation into the critical success factors for EMR access systems and proposes a theoretical model of these factors. These results indicate that the concerns of all the users of an EMR have a significant impact on the success of an EMR system implementation in a secondary/tertiary care health care institution that can be accessed by primary care health professionals. If these concerns are not met, use of the system will be limited, the benefits of such a system will not materialise, and the implementation project will not be successful.

Chapter 2 - The Research Process

The purpose of this research project is to identify the critical success factors for access to an electronic medical record system held within a secondary health care institution by primary health care professionals who may not be employees of that secondary health care institution and to develop a theoretical model for such factors.

2.1 Objectives

In order to identify these critical success factors, the following objectives were developed:

1. identify the user requirements for primary care health professionals interfacing with an electronic medical record at the secondary health care institution
 - 1.1. determine who should have access to what information?, how much information? when should they have access? why should they have access? how should the information be accessed?
 - 1.2. identify the electronic medical record system requirements of the secondary care obstetric unit with regards to the primary health care professional users
 - 1.3. investigate any data issues concerning the transfer and access to information especially concerning Mental Health, Sexual Health, and termination of pregnancy services
2. develop a medical records access systems critical success factor model report based on the user requirements report
3. study the current developments in other health providers, mainly in New Zealand, Europe and the United States and identify the advantages and disadvantages of the current developments

2.2 The Thesis Structure

In order to meet the objectives of this research project, the following research process was developed, following the guidelines by Lucas (1991b) and Polgar and Thomas (1995).

- Chapter One - Introduction

This chapter introduces the research project and summarises the major findings.

- Chapter Two - Research Process

This chapter discusses the objectives and limitations of the research project and details the presentation structure of this thesis.

- Chapter Three - Literature Review

This chapter details the results of the literature review for the use of EMRs by primary care and secondary care, and the New Zealand and world-wide current developments regarding the use of EMRs.

- Chapter Four - Research Planning

This chapter identifies the research area, locates relevant theories for a model of EMR access systems, develops the research model, and delineates the hypotheses that will be the basis of the primary care survey.

- Chapter Five - Research Design

This chapter discusses the primary health care survey. It considers the formulation of the research design, the operationalisation of the variables, the identification of the sample, the design of the data collection instruments and the collection of the data.

- Chapter Six - Primary Health Care Survey Data Analysis

This chapter presents the results of the primary health care survey.

- Chapter Seven - Hypotheses and Model Testing

This chapter takes the results of the primary health care survey from chapter six, tests the hypotheses presented in chapter four and reports on the theoretical model development.

- Chapter Eight - Discussion

This chapter discusses the results of the primary health care survey and considers the implications of the findings for the implementation of an EMR at a secondary healthcare institution that may be accessed by primary healthcare professionals.

- Chapter Nine - Conclusions and Recommendations

This chapter presents the conclusions from this research project and proposes some recommendations for increasing the likelihood of successfully implementing an EMR access system between primary and secondary health care.

2.3 Limitations

Due to limited financial and time resources, and the academic requirements for this project, it was necessary to limit the scope of the research project. After lengthy discussion with all participants, the project investigated a generic theoretical model for critical success factors for electronic medical records (EMR) access, but limited the survey phase to those General Practitioners (GPs) who have access rights to secondary care obstetric services and hence are eligible to be lead maternity carers (LMCs). Whilst there are many primary health care providers, GPs are currently the largest group of funded primary health care providers and are thus the major referral group to secondary care. A comparison group of midwives eligible to be lead maternity carers, and specialist obstetricians working in primary care, in the secondary care institution catchment area were also surveyed to investigate the generalisability of the theoretical model. The research project will only consider those CSFs relating to EMR access systems in the developed world.

Obstetrics was chosen as a speciality because it has clearly defined boundaries and hence enabled the survey to address some of the issues of the type and nature of the data that may be transferred between primary care and the EMR in the secondary health care institution and any problems with such a transfer of data. These issues are discussed in the literature review in Chapter Three.

Thus, the research project focused on the specific factors relating to EMR access within obstetrics in the secondary health care institution catchment area, but it was the intention of the research project that the generic model will be able to be transferred into other areas of primary-secondary care interface. It is acknowledged by the author that there are some limitations with this approach and recommend further research.

Some of the limitations include:

- ◆ a limited analysis of the various published methodologies relevant to the area of study
- ◆ the primary health care survey results will need to be validated
- ◆ the generalisability of the final theoretical model will need to be tested
- ◆ the concerns, issues and requirements of patients will not be addressed
- ◆ the concerns, issues and requirements of different cultural groups will not be addressed
- ◆ the influence of the Treaty of Waitangi on the structure, access and use of EMRs in New Zealand will not be addressed
- ◆ the CSFs for developing countries will not be addressed
- ◆ some factors identified which may affect GP computing will not be analysed
- ◆ further research will be necessary to investigate variables affecting EMR access by GPs in areas other than obstetrics
- ◆ further research will be necessary to investigate variables affecting EMR access by other primary health care professionals and other groups who will have legitimate access to the electronic medical record
- ◆ some technical aspects are not considered

Chapter 3 - Literature review

This chapter details the results of the literature review for the use of EMRs by health professionals. As it is the intention of the secondary health care institution that the EMR is accessed by individuals, the critical success factors for end-user computing, both in general and by health professionals, were included in the literature review.

3.1 Methodology

The following methods of reviewing the existing published literature were undertaken:

- Medline search via Massey University library and the Internet.
The search keywords were: general practitioners/GPs, National Health Service/NHS, electronic medical record, primary care and then each combined with the following in turn: general practitioners/ electronic medical record/ electronic patient record/ communication/ computing/ electronic/ informatics/ computers/ end-user computing/ computerised medical record/ computerised patient record.
- Various medical sites on the Internet were visited, and relevant abstracts and references downloaded.
- Electronic and manual journal search at various hospital libraries and my own personal medical library (cf.: Appendix 1 for a list of journals).
- Literature search at the libraries at Massey University, various hospital libraries and my own resource books, including resource books from business studies and management as well as medicine/general practice.
- Review of published research relating to New Zealand General Practice in the General Practice Research Reference Directory 1965-1994 (RNZCGP 1996a).
- personal communication with other researchers in health informatics in Europe and the USA and Canada via the Internet and e-mail
- extensive networking with GP and medical colleagues

3.2 Order of the literature review

The following order of investigation was undertaken to identify the published factors that may be required for successful access to EMR by GPs with the results discussed in each of the following sections:

- a) identify the use of information technology and EMRs within the healthcare field
- b) identify critical success factors (CSFs) for general end-user computing
- c) identify general features of GP computing
- d) identify requirements for EMR access by GPs
- e) identify the potential impact of non-GP groups or organisations on EMR access by GPs
- f) identification of CSFs for GP computing were derived from a) to e) above

The literature review concentrated on GP computing as they are the largest group primary healthcare providers who refer to secondary care (Stringer 1992). The results from the midwife and obstetrician respondents in the primary care survey are used to extend the body of literature relating to primary health care professionals' use of computers and EMRs and to extend the generalisability of the theoretical model.

3.2.1 The use of information technology and EMRs in health care:

The first section in the literature review considers the role of information technology (IT) and EMRs in health care, the definition of an EMR and the advantages, disadvantages and major concerns regarding IT and EMR usage in health care.

Role of IT and EMRs in health care

The use of information technology in increasing efficient integration of primary and secondary care is one of the main strategies of the current health reforms in New Zealand (Central Regional Health Authority 1996a; Minister of Health 1996). Improved communication and information flow has a major part to play in this

integration (Tilyard, Phillips, Dovey, Skelly, Whitney 1991; Turnbull 1992; Britt and Miller 1993; GEHR 1993; Central Regional Health Authority 1996a; Minister of Health 1996).

Electronic transfer systems, involving computer linkages between providers, with a shared data base, are a means to this improved integration between primary care and secondary care and also between other agencies such as pathology services, pharmacies, community care services, purchasers, and many others (McCormick and Boyd 1994; NZHIS 1996b). An electronic medical record (EMR), consisting of a shared database, may form part of such an electronic transfer system. Plans for the development of healthcare information networks and models using electronic transfer systems and EMRs are also under way in the USA (NZHIS 1995d), in Australia (Britt and Miller 1993; NZHIS 1995e), in the UK (Britt and Miller 1993; Miller and Britt 1993; Pressley 1996), and in Europe (IMIA Workshop 1990; GEHR 1993).

Safe and effective health care delivery requires access to a patient's medical history (CHIP 1997a; Lilienthal 1997) and one of the main aspects of primary health care computing is to have "effective recording of patients on-going medical histories" (IMIA Workshop 1990 pg v). At present, information related to a patient's medical record is fragmented and may be obtained from a variety of sources. These sources include the patient, friends, family and whanau, existing medical records in individual health care practices and hospitals, individual health care professionals, and diagnostic services (IMIA Workshop 1990; Wyatt 1994; NZHIS 1995b). These multiple sources of patient data make accessing a complete medical history a very difficult task for a health care professional. Paper medical records have additional disadvantages including missing records, duplication, bulk, incompleteness, difficulty in searching for required items of data, lack of confidentiality, lack of audit capability, and frequently fail in answering questions that arise in routine patient management (Wyatt 1994; NZHIS 1995b; NZHIS 1996b). Exchanging information contained in paper records requires increased work and raises the problem of transcription errors, and health care providers can spend at least 20% of their time reading, writing, sorting and searching through

paper records (NZHIS 1995b). Fully electronic medical records have been proposed as a solution to the problems of paper records (Foote 1990b; Wyatt 1994; NZHIS 1995b; NZHIS 1996b). The next problem is therefore to define what constitutes an electronic medical record (EMR).

Definition of an EMR

There are various meanings of the term ‘electronic medical record’ and ‘computerised medical record’ which are used inter-changeably by many people. There are five levels of computerisation of patient information systems:

- level 1: automated medical records
 - level 2: computerised medical record system
 - level 3: the electronic medical record
 - level 4: electronic patient record system
 - level 5: the electronic health record (M.B.C. 1996)

Electronic medical records are health care records that are created and stored on computer and may be transmitted in electronic form (GEHR 1993). The term health care record will be used synonymously with patient record and medical record in this research project. The definition of what constitutes a health care record for this research project is given in the GEHR document:

“it is important to accept that if a patient is to have control over something, and if a clinician is going to be accountable for the use and content, then it must be absolutely clear to all parties what is and what is not the health care record. For the purpose of this document it is all recordings made by a responsible clinician regarding the care of that patient. Thus information does not form part of the health care record until a clinician had taken responsibility for that information and entered it into the record” (GEHR 1993, The Good European Health Record Ethical and Legal Requirements Deliverable 8 19 October: pg 5). This definition highlights the importance of deciding who can enter information and that that person must be identified as responsible for that information.

Having decided on a definition for an EMR, the advantages and disadvantages of an EMR as a solution to the problems of paper records can be considered.

Advantages and Disadvantages of EMRs in health care

Fully electronic medical records have been proposed as a solution to the problems of paper records by providing benefits of availability, transfer and retrieval; linkage; storage; multiple data views; reporting and abstraction; quality and standards assessment; and decision support (Foote 1990b; Wyatt 1994; NZHIS 1995b; NZHIS 1996b).

However, despite an increasing trend towards implementing a fully electronic medical record (EMR) over the last five years, and much discussion about such EMRs, they have been comprehensively implemented by few health care providers (CHIP 1997c). The NZHIS considers that the obstacles to the adoption of EMRs are mainly related to practices and people, and much less to the technology (NZHIS 1995b). The advantages and disadvantages of EMRs can be considered from different viewpoints - technology, social, medico-legal, and the type of use for, and different users of, an EMR. The problems with technology will be considered first, then those that relate to practices and people.

Technology problems

Whilst the technology required for EMRs already exists (NZHIS 1995b), there are some technical problems with EMRs. There is a lack of standardisation of data structures, vocabularies, communication protocols and user interface models (IMIA Workshop 1990; Miller and Britt 1993; CHIP 1997a, 1997b). There is a proprietary interest in existing electronic medical records which prevents the development of new technologies (CHIP 1997a). Current EMR systems do not use the available 'state-of-the-art' information technology and are vulnerable to breaches in privacy (CHIP 1997a, 1997b). There are inadequate, incomplete, multiple incompatible coding systems, especially between primary and secondary care (IMIA Workshop 1990; Jurd, Britt, Miller and Brooks 1995; Ferguson 1996; Simon 1996b; Gardner 1997). The need for standards and definitive data

dictionaries is highlighted in the potential for trans-border flows of health care data, telemedicine and long-distance consultations, and the importation/exportation of medical software - of all of which require data to be translated between languages without alteration or loss of meaning. Using a definitive data dictionary and adhering to common standards will ensure compatibility across the health care sector and avoid duplication ensuring cost effective use of information technology (NZHIS 1995a; NZHIS 1996a). All these issues mean that accessing data from different EMRs held by different health care providers is either impossible or very costly and difficult (CHIP 1997a).

Practices and people problems

The problems with EMRs that relate to practices and people are summed up by the NZHIS (1995b) who considers that it is very important and urgent that the "legal and social frameworks for the acceptance, introduction and implementation of electronic patient records need to be developed, debated and established" (NZHIS 1995b pg 10).

The social framework is important as an EMR can operate in the interests of a number of people and has potentially a wide audience. It is a record of individual patient care for clinicians, a form of communication between professional colleagues, may be required as medico-legal evidence, is a way of collecting detailed statistical information about the performance of the clinician and the health services and provides a means to improve the provision of care by the same or by another clinician (Pritchard, Low and Whalen 1984; Foote 1990b; IMIA Workshop 1990; Dowling 1992a; GEHR 1993; Kelly 1993; McCormick and Boyd 1994; NZHIS 1995b). Thus, medical records can be used in patient management, health care prevention, clinical research and epidemiology, education, clinical audit, and health services management and contract management (IMIA Workshop 1990; GEHR 1993; Wyatt 1994; NZHIS 1996b).

The benefits and problems of information technology and EMR use within health care can be viewed from several social perspectives: patient care, the doctor, the

health institution, and society in general. These benefits and problems are discussed in the following sections.

Secondary healthcare benefits and problems

Within the secondary health care institution, the potential benefits from information technology systems are summarised as follows:

Overall benefits

- Has enabled the development of a bridge between basic research and clinical practice
- Previously prohibitively labour intensive research projects have been able to go ahead
- The notes were legible
- Medical audit became possible
- A single interface with the administrative software facilitated maintenance at a lower cost
- Geographical restrictions removed
- Duplication eliminated
- Cultural evolution within the hospital staff

Referral to or attendance at casualty department

- Easier access to medical history as patient record immediately available

Outpatient clinic

- Improved access to summary details
- All records accessible on all visits to clinics throughout the hospital
- Easier and quicker production of clinic letter to general practitioner

Admission

- Improved access to summary patient details
- Support for protocols or guidelines
- Easier access to results of investigations
- Quicker reporting of results of treatment
- Mean duration of stay decreased

- Staff could follow a patient's progress through the hospital

Discharge

- Easier generation of discharge summary for general practitioner
- More reliable data to support audit
- Shared care better supported with community based professionals

(Lock 1996; M.B.C. 1996; Kohane 1997).

The specific CSFs identified in the literature review for the use of EMRs by secondary health care institutions are:

- end-user acceptance
- end-user participation, including representation from each area of health care speciality who are willing to work hard and some of whom have computer knowledge
- data security, integrity, and privacy
- immediate access and availability, including by modem or Internet access
- user friendly systems, including allowing paper and tape dictated submission of data
- strategic planning and project management
- the use of standards for data dictionaries, technology and communications
- be prepared to wait for benefits
- accept that no perfect solution exists

(IMIA Workshop 1990; CERC 1996; M.B.C 1996; Richards 1996; Kohane 1997; Naegele 1997)

In general, the major CSFs relate to people and data issues not with technology. This supports the findings throughout this research project that it is the people and data issues that are of major concern and must be addressed. The technology, although important, is secondary.

Within New Zealand, the secondary health care institutions are divided into Crown Health Enterprises (CHEs). Few CHEs share data electronically with other organisation, despite all using computers for many of the financial and

administrative functions, and very few CHEs use EMRs. Also very few CHEs use the same or similar information systems such as patient management systems (NZH&H 1995a; NZH&H 1995b; NZH&H 1995c; NZH&H 1995d; NZH&H 1996; NZHIS 1996c). Whilst most CHEs believe that the use of EMRs and electronic data sharing will increase markedly in the future, most appear to be waiting and watching rather than implementing an EMR (NZHIS 1996c; Hunter 1997).

Confidentiality, privacy and security are major issues for secondary care providers and there are no monitoring systems in place to detect breaches in security (NZHIS 1996d; Hunter 1997). Ownership of medical records is unresolved, accountability regarding the use of EMRs unclear, and the sharing or distribution of the cost associated with data collection, management, retrieval and sharing is contentious (NZHIS 1996d; Thakurdas, Coster, Gurr, Arroll 1996; Hunter 1997). The majority of CHEs plan to maintain a dual paper/manual medical record system (Hunter 1997).

Although some CHEs are considering implementing an EMR that could be accessed by primary health care professionals, a survey of the New Zealand CHEs showed that the majority of CHEs are undecided about allowing such access, and would restrict such access to reading and transferring data to the EMR, the altering of data in the EMR would not be allowed (Hunter 1997). The actual mode of access is undecided by the majority of CHE respondents but may involve the Internet (Hunter 1997).

There were a variety of concerns that the CHEs expressed that need to be resolved before there will be widespread adoption of EMRs within New Zealand secondary health care institutions. In particular, these concerns relate to the security and confidentiality of patient information, adhering to the privacy laws, obtaining patient consent for the health professional to access their data with limiting access to certain types of information, such as psychiatric records, and to certain health care professionals, and obtaining medical users' acceptance of working with EMRs and their agreement to release information (Hunter 1997).

Another major barrier to the increased adoption of EMRs in New Zealand, both in primary care and secondary care, is the lack of national and regional direction, co-ordination, planning and advice, the lack of the provision of the required infrastructure including the policies, standards, networks and communications and the lack of any agreement regarding the sharing of information between organisations (Jurd et al 1995; Ferguson 1996; Simon 1996b; NZHIS 1996c; NZHIS 1996d; Hunter 1997; Gardner 1997).

Primary health care benefits and problems

Information technology within primary care, appears to help in improving preventative care, management and co-ordination of health care, use of services, efficiency, satisfaction, access, but is less effective in improving continuity of care, morbidity, and mortality (Yano, Hirsch, Robbins, Ribenstein 1995).

Primary health care is defined differently in different countries in the world (IMIA Workshop 1990) so the definition of primary health care used in this research project is that of health and disability care provided in the community involving a first point of patient contact and may not require a medical doctor (IMIA Workshop 1990; CRHA 1996).

Sullivan and Mitchell (1995) reviewed 30 published reports to study the effect of desktop computer use in primary care consultations. They found that the introduction of computers has a positive effect on doctor performance, from 8% to 50%. Computerisation affected the consultation process in that the overall length of time was increased but patient-initiated and "social" conversation was decreased. They commented that there are very few studies looking at the effect of computing on patient care and outcome - they found only three such studies and only one showed any improvement in patient outcome.

However, despite the lack of information regarding the effect of computers on the quality of patient care, computers in primary care do have certain advantages. They can store information in electronic form, such as a EMR, in a way that enables it's

easier retrieval than from paper patient records. They are able to perform routine tasks flawlessly, such as prescription and referral letter writing, patient recalls, and accounting/billing, once set up right and given the right information (Holland 1996; Klijakovic 1996). In general, these benefits of information management by computerisation in primary care are in the quality of practice rather than in providing monetary advantages (Holland 1996).

Computer use in primary care also have certain disadvantages. Change and learning new skills can be stressful, time-consuming and even embarrassing. The time saved in performing routine tasks is, in fact, rarely saved, it is simply used to do other things. This may be seen as an advantage, rather than a disadvantage, as GPs never have enough time to do everything, and hence any 'extra' time is always useful. Computers may also cost more time in data inputting, maintenance and upgrades. Similarly, computers cost money for hardware, software, maintenance, mailboxes, materials such printer ink, paper, and even in space, both physical space for the equipment and disc space for storage. The paperless office is not a reality in most GP practices, hence storage for paper records is still required (Holland 1996; Klijakovic 1996; Purves 1996). Primary care use of computers, and thus of EMRs, is also subject to the same technology problems as secondary care (NZHIS 1996c; 1996d).

Medico-legal and ethical framework

The medico-legal and ethical framework relating to medical records, including the role of patient consent, have an enormous impact on EMRs (Pritchard et al 1984; Walls 1989a; Dowling 1992a and 1992b; Health Information Privacy Code 1994; Campbell, Gillett and Jones 1992; Townsend 1993). EMRs must be able to demonstrate attribution; maintain an audit trail; have validation mechanisms to prove data integrity both of transferred data and the data source, and of the records application software; provide record confidentiality and protection; and enable user identification and provide access control (Foote 1990b; Dowling 1992a; NZHIS 1995c).

In summary, there is extensive interest in the use of EMRs in health care but little published information regarding the successful use of EMRs. The concerns and problems regarding the use of EMRs world-wide in secondary health care institutions mirror that of primary health care users. They include a lack of standardisation of data structures, vocabularies, coding systems, communication protocols and user interface models, use of out-of-date hardware, and problems with security, privacy and confidentiality (Foote 1990b; IMIA Workshop 1990; Miller and Britt 1993; Townsend 1993; Jurd et al 1995; Ferguson 1996; NZHIS 1996c, 1996d; Simon 1996b; CHIP 1997a, 1997b; Gardner 1997; Hunter 1997).

Current developments regarding the use of EMRs in New Zealand follow that of elsewhere in the world. Success lies more with the decision capability, the human team, the acceptance of the modification of the organisation than with the properties of the software. New Zealand has an excellent opportunity to learn from the mistakes of other countries and to develop an EMR system that uses data, communication and technology standards permitting the ultimate development of a national EMR or at least, the transfer of information nationally. This will then meet the main objective of the current health reforms to increase efficient integration of primary and secondary care by allowing improved communication and information flow.

In view of the trend towards computerisation and the use of EMRs to assist in improving the efficient integration of primary and secondary care (Tilyard et al 1991; Turnbull 1992; McCormick and Boyd 1994; NZHIS 1996b; Simon 1996c; CHIP 1997c), and the advantages and disadvantages of health care computerisation, it is appropriate to consider 'what are the factors that will improve the acceptance of information systems within general practice, particularly the adoption of a system to access electronic medical records held in secondary health care institutions' (Brown and Coney 1995) and to attempt to resolve the key questions relating to EMRs - "who will enter which data, when, where, using what technology, and for what purposes?" (NZHIS 1995b pg 9). This is the purpose of this report.

It is therefore important to consider who will be the users of the EMR (endusers) and what are the factors that affect the successful use of the EMR by these endusers.

3.2.2. Critical Success Factors for general End-User Computing

This section considers the concept of the end-user, the problems with allowing end-users interact with information technology, and thus with EMRs, and identifies specific areas in which the critical success factors for end-user access will be located. The definitions of critical success factors and end-user computing success will also be considered in this section.

General end-user computing

Computer end-users can be divided into three categories - indirect, intermediate and direct end users (Codasyl End-user Facilities Committee Status Report 1979, cited in Rockart and Flannery 1983). Direct end users are the people who actually use the information system themselves. Rockart and Flannery (1983) further subdivided direct end users into six distinct classes of end-users - non-programming end users, command level users, end-user programmers, functional support personnel, enduser computing support personnel, and DP programmers. The secondary health care institution is considering granting access by GPs as non-programming and command level end-users only, to their new EMR system. The other categories of end user will be provided by the secondary health care institution, so GPs are being considered for information access and updating and simple querying. The actual system programming, maintenance and support will remain under secondary health care institution control. Hence, it is the critical success factors (CSFs) of direct non-programming and command level end-users (end-user computing) that are considered in this research project.

There are eight potential problem areas in the introduction of end-user computing (EUC) into an organisation:

1. business controls

2. financial controls
3. hardware compatibility and maintenance
4. software and application issues
5. telecommunications concerns
6. data and database concerns
7. issues relating to people
8. political, cultural, and policy issues (Frenzel 1992.)

The first four problem areas above are addressed by the secondary health care institution maintaining control over the hardware, software, telecommunications and maintenance. There may develop a potential area of concern if GPs in their own surgeries are to electronically interface with data in the secondary health care institution system rather than interface with the system physically on secondary health care institution premises. This aspect has not yet been decided and there will be a range of CSFs related to telecommunication access alone. Thus, the areas of potential problems in introducing EUC to GPs by the secondary health care institution lie in the areas of data and database control, issues relating to people, to political, cultural, and policy issues and potentially to telecommunication.

The development of GP EUC is similar to the introduction of office automation, in that it is looking at information transfer from the GPs to the secondary health care institution and visa versa, a similar function to the information handling and processing that is performed in offices. It can be viewed as a special subset of EUC. Frenzel (1992) discusses that an important step in planning for office automation are to understand the current environment and that successful implementation is highly dependent on human factor considerations, i.e.: that the software is easy-to-use, the physical environment is designed to reduce stress and that careful attention to human factors will reduce resistance to change, speed the implementation, and improve morale (Frenzel 1992).

In summary, the focus of this research project is on the human factor issues, data and database issues and political, cultural, and policy issues relating to the planning, implementation and operation of GP EUC. It is in these areas that the

critical success factors will be looked for, therefore it is appropriate to consider what constitutes a critical success factor.

Critical success factors (CSFs)

Critical success factors are “those few areas where things must go right; they are the executive’s necessary conditions for success” (Rockart 1979, cited in Frenzel 1992, pg 27). There are four areas where critical factors can be located. These are in the industry in which the firm operates; the company itself; the environment; and time-dependent organisational areas. There are also two types of CSFs, the monitoring type and the building type. The building type initiates activity designed to change the functions of the organisation in some way (Rockart 1979, cited in Frenzel 1992).

Another way to consider CSFs is to look at them from the point of view of strategic planning. Critical success factors can be found in strategic and competitive issues, planning and implementation concerns, operational items and business issues (Frenzel 1992). The secondary health care institution is the organisation and owner of the information system, hence the focus of strategic planning for the new information system. The strategic, competitive and business issues have been addressed by the organisation in their decision to investigate the possibility of granting access to the EMR to GPs. The areas that will affect access by GPs to the system will therefore be in the planning, implementation and operational issues of the information system.

From the perspectives of both the GPs and the secondary health care institution, the critical success factors can be located in the areas of the medical profession, themselves, and patients (the industry), the secondary health care institution (the organisation), the current health reforms in general (the environment), and the rapid evolution of information technology within both the organisation, the medical profession and society (time-dependent areas).

The current health reforms and the development of Independent Practitioner Associations (IPAs) are the 'push', towards computerised integration between primary and secondary care (Walls 1989b; Tilyard et al 1991; Turnbull 1992; McCormick and Boyd 1994) and will not be considered further in this research project.

Patient requirements and the specific critical success factors for patients' adoption of an EMR is an area that justifies a research project in its own right and while the importance of patient's rights are acknowledged as a major issue relating to medical records, the scope of this research project precludes an analysis of this area and it is left to another project (Kennedy-Grant 1991; Buchan and Paul 1992; Collins 1992; West 1992; Fisher 1993; GEHR 1993; NZMA Newsletter 1993; Townsend 1993; Donaldson 1996).

Thus, this research project aims to identify the building factors involved in the planning and implementation concerns and the operational items required for successful EMR access by GP end-users. The factors investigated will lie within the areas of the medical profession, the individual GP, the secondary health care institution and the rapid evolution of information technology within both the organisation, the medical profession and the general community (time-dependent areas).

Having defined the end-user and critical success factors, and identified the areas within which the CSFs may lie, the next problem was to consider how to actually measure direct end-computing success.

Definition of end-user computing success

Success can be viewed from the perspective of the organisation and their information system (IS) department or from the end users (Zinatelli 1994). This research project is examining CSFs from the perspective of the direct end users, hence it will not investigate the measurement of IS success or the variables

affecting successful information system planning and implementation from the IS department's perspective. That is left for another project.

There are a variety of problems with the existing surrogate measures of EUC success:

1. No consensus.

One of the main problems in determining the variables that affect end-user computing (EUC) is to identify those criteria by which to measure EUC success. Unfortunately, there is not uniform agreement in the literature resulting in different criteria being used by different researchers to measure EUC success.

Computer utilisation and user satisfaction are the two commonest surrogate measures of EUC success (Ives and Olson 1984; Cheney, Mann, and Amoroso 1986; Rivard and Huff 1988, cited in Pomare 1992; Davis 1989; Davis et al 1989; Doll and Torkzadeh 1989; Gogan 1989, cited in Pomare 1992; Igbaria 1990, cited in Pomare 1992; Thompson, Higgins, and Howell 1991; Pomare 1992; Kivijardi and Zmud 1993; Zinatelli 1994; Yoon, Guimaraes and O'Neal 1995).

However, other surrogate measures of EUC success have been used by researchers including perceived utility (Ives and Olson 1984; Kivijardi and Zmud 1993); goal realisation (Kivijardi and Zmud 1993); tasks performed (Igbaria 1990, cited in Pomare 1992); perceived effectiveness (Igbaria 1990, cited in Pomare 1992); and adoption of an innovation (Moore and Benbasat 1991).

Two major reviews of EUC success measures were conducted by Ives and Olson (1984) and Yoon et al (1995). Their reviews demonstrate the variety of EUC success measures available in the literature. Ives and Olson (1984) divided the measures into four groups with the number of studies that used these measures - measures of system quality (6 studies), system usage (6 studies), perceived quality/information satisfaction (12 studies), and changes in behaviour/attitudes (7 studies). They considered that user acceptance is a product of system usage and user behaviour and attitudes. Similarly, Yoon et al (1995) found user satisfaction was used by 4 researchers, level of system usage by 2 researchers, perceived

benefits of systems by 2 researchers, improved decision quality and performance by 3 researchers, and business profitability by 3 researchers.

2. Multiple measures used in the one study.

An additional problem with the use of measures of success is that frequently, more than one measure is used by a researcher and that different researchers have used different groupings of measures. For example, one measure was used by Cheney et al (1986); Rivard and Huff (1988, cited in Pomare 1992); Doll and Torkzadeh (1989); Moore and Benbasat (1991); Pomare (1992) and three measures were used by Zinatelli (1994). Four measures were used by Igbaria (1990) and Kivijardi and Zmud (1993).

3. Measures are applied to large firms.

A third problem with the use of surrogate measures of EUC success is that the majority of studies refer to large firms (Rivard and Huff 1988, cited in Pomare 1992; Moore and Benbasat 1991; Thompson et al 1991; Yoon et al 1995; Jiang, Klein and Pick 1996) or universities (Davis, Bagozzi, and Warshaw 1989; Adams, Nelson, and Todd 1992; Harrison and Rainer 1992; Pomare 1992; Igbaria, Guimaraes and Davis 1995).

However, GPs work in solo practices or in small group practices (Walls 1989b; Gribben, Bonita, Broad, McAvoy, Raymont 1995; RNZCGP database 1995; Klijakovic 1996; RNZCGP database 1996; Thakurdas et al 1996). There are differences between the adoption and use of computers between large and small firms and hence the measures that are appropriate to use in measuring EUC success between large and small firms may be different (Cragg and King 1993; Zinatelli 1994; Iacovou, Benbasat, and Dexter 1995).

The commonest surrogate measures of EUC success used by studies based on small firms are system use (Vitalari and Venkatesh 1991; Zinatelli 1994), system utilisation, and EUC satisfaction (Zinatelli 1994); system adoption, integration and impact (Iacovou et al 1995); and IT growth (Cragg and King 1993). The study by

Zinatelli (1994) is particularly applicable to this research project as not only was it based on small firms but these firms were in New Zealand.

4. Weak measures.

A final problem in measuring system success is that the existing measures for user involvement and system success are generally weak, suffer from a lack of a theoretical foundation and have not subjected to extensive validation (Ives and Olson 1984).

These problems of success definition and subsequent measurement demonstrate an inherent problem with MIS research. Each definition and measure has advantages and disadvantages and the choice of the optimum measure for system success thus depends on the study objectives (Yoon et al 1995). The objectives of this research project are to identify the CSFs for EMR access systems by end-users.

The success measures of system use, system utilisation, and EUC satisfaction were selected by this research project as they are commonly used, have been validated to at least some extent, have existing measurement scales, have been applied to small firms, have a theoretical foundation and fit the objectives of the project. The research project will be able to build on and add to the existing research literature.

In summary, this section considered the definitions of critical success factors and EUC success. It identified that the areas, within which the CSFs for introducing EUC to GPs by the secondary health care institution will lie, to be the areas of the medical profession, the individual GP, the secondary health care institution and the rapid evolution of information technology within both the organisation, the medical profession and the general community. The factors will involve the areas of data and database control, issues relating to people, and to political, cultural, and policy issues relating to the planning, implementation and operation of GP EUC. The factors may also include the area of telecommunications.

The issues and problems regarding measuring EUC success were discussed and the success measures of system use, system utilisation, and EUC satisfaction were

selected to be used by this research project. The next step is, therefore, to identify those variables that will influence these success measures. This is discussed in the next section.

3.2.3 Variables Influencing general EUC success

This section will consider any variables that have been shown in previous published IS studies to influence system use, system utilisation, and EUC satisfaction. These variables will then be proposed as general CSFs for EMR access systems.

Relating back to the areas within which these CSFs will be found, the question becomes “what then are these specific variables within the human factor, data and database issues, possibly the telecommunications area, and the political, cultural, and policy issues relating to the planning, implementation and operation of GP EUC?”

Looking at the various published models and approaches used in determining EUC success factors, it is apparent that many different variables have been found to be related to EUC success or surrogate measures by different researchers. Thus, identification of influencing variables on GP EUC success have the same problems as identifying appropriate measures of EUC success - that of no consensus, multiple variables used in the one study, variables that are applied to large firms may not be applicable to small firms, and existing variables may lack theoretical foundation and have limited validation (Eveland 1991; Gurbaxani and Mendelson 1991; King 1991; Kraemer and Dutton 1991; Lucas 1991a; Mason 1991; Thompson et al 1991; Zmud and Boynton 1991; Zinatelli 1994; Iacovou et al 1995; Cragg and King 1993).

The various variables that have been found to influence EUC success can be divided into intra-organisational variables, extra-organisational variables, and variables that influence the individual. Some variables were identified in studies on small businesses but the majority are from studies involving large businesses. The following review of the literature is therefore divided into corresponding sections.

Intra-organisational variables influencing EUC success

Cheney et al (1986) looked at organisational factors affecting the success of end user computing. They divided the organisational variables affecting EUC success into uncontrolled variables, partially controlled variables, and fully controlled variables, as determined by the ability of management to control the variables.

They found that the following organisational variables influenced EUC success:

- uncontrollable variables were found to be:

- ⇒ level of management support
- ⇒ task structure
- ⇒ task repetition
- ⇒ task independence
- ⇒ organisational time frame

- partially controlled variables were found to be:

- ⇒ psychological climate (expectations of management and end-users)
- ⇒ large system development backlog

- fully controllable variables were found to be:

- ⇒ EUC training
- ⇒ rank of responsible executive
- ⇒ corporate policies

These findings have been supported by other researchers.

Thompson et al (1991), in their study of computer use in a multinational manufacturing organisation, found that social factors such as peer, superior and organisational norms for computer use, influenced the intensity of computer utilisation. Social factors were also considered by Janis Gogan (1989, cited in Pomare 1992), who developed a model looking at variables affecting IT use and divided them into social, individual and work contexts. The social context included variables both within the organisation, including peers/subordinates/superiors/trainers and outside the organisation, such as mass media/social contacts/business contacts variables.

Thompson et al (1991) also found that facilitating conditions for PC use by the provision of training and support influenced the intensity of computer utilisation. Internal training was also considered by Cheney et al (1986), Nelson and Cheney (1987), Sein, Bostrom and Olfman (1989), Igbaria (1990, cited in Pomare 1992) and Zinatelli (1994). Internal support was found to relate to EUC success by Rivard and Huff (1988, cited in Pomare 1992), Igbaria (1990, cited in Pomare 1992), Danziger and Kraemer (1991), Thompson et al (1991), and Zinatelli (1994).

Igbaria et al (1995) also studied organisational variables and found that user training, system quality, EUC support, and management support were related to perceived ease of use, perceived usefulness and system usage and thus to EUC success.

Managerial support has been considered by many researchers besides Cheney et al (1986) and Igbaria et al (1995). Managerial enthusiasm was found by Cragg and King (1993) to be a motivator of IT growth in small firms and that an inhibitor to IT growth was a lack of managerial time. Iacovou et al (1995) found that managerial assistance, especially from larger trading partners, was required to increase the adoption of electronic data interchange (EDI) by small organisations. Zinatelli (1994) found that managerial support was directly related to perceived usefulness and to EUS satisfaction. Yoon et al (1995) found that managerial support was related to user satisfaction.

Corporate policies were also considered by Cheney et al (1986), and by Danziger and Kraemer (1991). Organisational readiness was found to relate to overall user satisfaction by Rivard and Huff (1988, cited in Pomare 1992) and an inappropriate environment set-up was considered by Partow-Navid (1987) to be a factor in their analysis of EUC failures.

Individual variables influencing EUC success

Individual variables influencing EUC success have been considered by many researchers and can be divided into those variables that relate to the end-users

attitude towards the computer or application, to the utility of the computer or the specific application, or to the technical aspects of the computer or specific application that influence an individual's use of the computer or application.

End-users attitude towards the computer or application

The variables that may influence an end-user's attitude towards a computer or an application include computer experience, computer anxiety, individual demographics such as age, gender and education, motivational issues, cognitive issues, and user participation. The use of change management also influences an end-user's attitude/acceptance.

The numerous variables that can influence EUC success is shown by a study by Vitalari and Venkatesh (1991). They conducted a longitudinal national sample of 614 households that purchased personal computers for home use which was published by them in 1989 ("Project NOAH: A Longitudinal Analysis of Computing in the Home." Technical Report, Graduate School and Management and Public Policy Research Organisation, University of California, Irvine, 1989). They found that the number of users in the household, the dollar amount spent on computing, employment hours per week, job related and word processing uses and reading computer material are positively related to computer use. People who spent more time on paid work also spent more time using the computer at home - which may be because computers were viewed as work-orientated tools and thus as more indispensable by people with heavy work schedules. A high regard for computers in terms of their symbolic or instrumental role also has a positive correlation with computer use. Programming use is negatively related to computer use and education had a weak, not significant negative relationship. Interestingly, prior computer training had a negative correlation with computer use. This contrasted with other researchers who found that computing training had a positive correlation with computer use (Cheney et al 1986, Nelson and Cheney 1987; Sein et al 1989; Igbaria 1990, cited in Pomare 1992; Zinatelli 1994). This may be because these studies were based on businesses whereas Vitalari and Venkatesh (1991) studied home personal computer users.

This study highlights some of the multiple variables that may relate positively or negatively to computer use. Many of these variables have also been investigated by other researchers.

Harrison and Rainer (1992) found that the personal characteristics of the individual end user computing personnel in their study accounted for 56 percent of the variation in their computer skill. Their results showed that gender, age, computer experience, computer anxiety, attitudes towards computers, fear of computers, maths anxiety, and level of individual creativity were all related to EUC skill. Computing knowledge, skills and previous experience were also found to relate to EUC success by Igbaria et al (1995) and the lack of these were found to inhibitors for IT growth by Cragg and King (1993). Age, education, system development experience and computer background, and managerial position are also related to the respondents' attitudes toward system development (Jiang et al 1996 and Rivard and Huff 1988, cited in Pomare 1992).

The relationship between the end-user's attitude towards the computer or application and EUC success has been investigated by many researchers (Ives and Olson 1984; Davis 1989; Davis et al 1989; Doll and Torkzadeh 1989; Moore and Benbasat 1991; Thompson et al 1991; Adams et al 1992; Zinatelli 1994; Yoon et al 1995). Ives and Olson (1984) in their review of the literature for measures of system success found that changes in user behaviour and/or attitudes were related to system success and included user resistance, a change in way of doing things, a perceived need for information, system acceptance, user attitudes, user behaviour, conflict resolution, changes in effort levels and new work patterns. Fred Davis (1986), and subsequent co-researchers, used the Technology Acceptance Model to show that perceived ease of use and perceived usefulness influenced attitude towards computer use which in turn influenced the behavioural intention to use computers hence influencing actual system use (Davis 1986, cited in Davis et al 1989; Davis 1989 and Davis et al 1989).

It is therefore appropriate to consider the relationship between user acceptance and EUC success further. This relationship is discussed in the next section

User acceptance and user participation in EUC success:

Nelson and Cheney (1987) and Joshi (1991) support the key role of user acceptance in EUC success as they discuss how most IS failures stem from a lack of user acceptance of the information technology rather than poor technical quality. Ives and Olson (1984) consider that user acceptance is one of two criteria for successful implementation of planned organisational change (the other being use of the new information system). Danziger and Kraemer (1991, pg 367) found that ‘the explanatory variables that seem most potent in accounting for variations in the impacts of computing on end users were those at the nexus between the computer package and the end user’ and include, in particular, human choice and action”. Similarly, Frenzel (1992) discusses that careful attention to human factors will reduce resistance to change, speed the implementation, and improve morale.

However, an individual’s attitude to, and acceptance of, the change that will occur from the implementation of information technology depends on their perceptions of the associated consequences, both of the inputs and the outcomes (costs and benefits). Therefore, user acceptance can be improved by using ‘equity theory’ - by reducing users’ inputs and negative outcomes, increasing users’ positive outcomes, and altering users’ perceptions of the inputs and outcomes by training, communication and fair procedures (Joshi 1991). User acceptance can also be increased by an examination of the cognitive factors and motivational factors of the users (Ives and Olson 1984), where cognitive factors include improving understanding of the system, improving assessment of system needs, and improving evaluation of system features; and motivational factors include increasing user perceived ownership of the system, decreasing resistance to change, and increasing commitment to the new system (Ives and Olson 1984). One way to accomplish the motivational factors is by end user participation.

End user participation in the planning and implementation of an information system has been considered by many researchers (Ives and Olsen 1984; Nelson and Cheney 1987; Doll and Torkzadeh 1989; Winfield 1991; Frenzel 1992; Kivijardi and Zmud 1993; Barki and Hartwick 1994; Hartwick and Barki 1994; McKeen,

Guimaraes, Wetherbe 1994; Yoon et al 1995) and is recommended by the NZHIS to be included in the implementation of any information system (NZHIS 1996b). As Kivijardi and Zmud (1993) stated “user participation is without doubt the most commonly offered suggestion for improving implementation success” (pg 162).

End user participation has other effects as well as improving implementation success, it gives a more real assessment of the information requirements of users, reduces the chance of developing unacceptable or unimportant features and end users will develop a better understanding of the system by being consulted (Ives and Olsen 1984). End user participation has a critical role in generating user acceptance by the simple fact that by their involvement in the planning and implementation, users will better understand the system, grievances will have been aired, fears expressed and addressed and hence a full commitment can be developed (Ives and Olsen 1984; Winfield 1991; Kivijardi and Zmud 1993). However, the relationship between user participation and EUC success is unclear (Ives and Olsen 1984; Barki and Hartwick 1994; McKeen et al 1994) and more user participation does not always equate with better outcomes (McKeen et al 1994).

There are degrees and differences in type of user participation, ranging from direct to indirect involvement and from actually designing the system to receiving information only or being consulted but having one's input ignored (Ives and Olson 1984; Barki and Hartwick 1994). Thus the degree of involvement can range from no involvement, through symbolic involvement, involvement by advice, involvement by weak control, involvement by doing to involvement by strong control (Ives and Olson 1984).

Winfield (1991) raises an important point regarding the time and costs of user participation. This has important implications for GP end-user participation when GPs already see computerisation as potentially disadvantageous in terms of their personal resources (Holland 1996).

Lack of user participation or token or pseudo participation can result in hurt feelings, the feeling of being ignored or of having been snubbed resulting in loss of goodwill and lowered staff morale causing a poor working atmosphere and can even generate resistance by the intended end users to the implementation and operation of the information system (Winfield 1991). User resistance leads to negative behaviours which can range from simple computer distrust and passive avoidance to displays of aggression and hostility and even to deliberately withholding data, providing inaccurate data or destroying data (Winfield 1991).

User resistance may be caused by unwanted change (Winfield 1991). "There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success than to lead in the introduction of a new order of things" and "for the reformer has enemies in all those who profit from the old order, and only lukewarm defenders in those who would profit from the new order, this lukeness arising partly from fear of their adversaries...and partly from the incredulity of mankind who do not truly believe in anything until they have had actual experience of it." (Machiavelli N. 'The Prince'. 1469-1527 cited in Winfield, 1991, p39). User participation is part of change management, a process of planning, co-ordinating and reporting changes in order to minimise the potential negative impact of those changes. It is a critical success factor in IS management (Frenzel 1992). It is also important in EUC. Therefore, user participation and change management leading to user acceptance is a CSF for EUC.

Utility of the computer or the specific application

Perceived usefulness has been considered a variable influencing EUC success by many researchers (Davis 1986, cited by Davis et al 1989; Davis 1989; Davis et al 1989; Gogan 1989; Moore and Benbasat 1991; Adams et al 1992; Kivijardi and Zmud 1993; Zinatelli 1994; Iacobou et al 1995). Ives and Olson (1984) in their review of the literature for measures of system success found the measures of system quality included performance, perceived value of reports, cost and time to develop, economic benefits, operational advantages, and IS improvements. Additional activities that relate to perceived usefulness or that have been found to

confer an advantage to users or to motivate IT growth and hence to influence EUC success and improved information processing, include: improved planning and control and work improvement (Cragg and King 1993); long term consequences of PC use (Thompson et al 1991); relative advantage and result demonstrability (Moore and Benbasat 1991); and goal realisation (Partow-Navid 1987; Kivijardi and Zmud 1993).

Technical aspects of the computer or specific application that influence an individual's use of the computer or application.

There are a variety of technical aspects of a computer or a specific application that make it more likely that an individual will use the system. These include how easy to use and how user-friendly the system is perceived to be, the access and availability of the computer/application and whether there is complete documentation.

Cragg and King (1993) in their study of small firms found that the inhibitors for IT growth included an unstructured system and poor software support and Partow-Navid (1987), in a study of decision support systems, found that incomplete documentation increases the likelihood of failure.

Access and availability of the computer/application was found by Pomare (1992) to relate to the utilisation of a PC. Gogan (1989, cited in Pomare 1992) and Danziger and Kraemer (1991) also related tool access to IT use.

User-friendliness and perceived ease of use has been found to influence user satisfaction and system use by Rivard and Huff (1988, cited in Pomare 1992); Davis (1989); Davis et al (1989); two studies by Adams et al (1992), and Zinatelli (1994). Moore and Benbasat (1991) found that ease of use is related to the diffusion of an innovation into an organisation. However, Yoon et al (1995) found that ease of use and ease of learning were less significant than individual end-user characteristics and management support.

Extra-organisational variables influencing EUC success

The final group of variables that have been found to influence EUC success is extra-organisational variables.

External support and training is discussed by Zinatelli (1994). She found that external support is directly related to perceived usefulness, EUC satisfaction , system utilisation and system usage and that external training was directly related to perceived ease of use and system utilisation.

Competitive and/or trading partner pressure was found to be a motivator for IT growth whereas inappropriate economic climate is an inhibitor for IT growth (Cragg and King 1993; Iacovou et al 1995).

Mass media, social contacts, and business contacts were found by Gogan (1989, cited in Pomare 1992) to influence IT use.

The various variables that have been investigated by the different researchers can be applied to the implementation process of an information system such as an EMR. This is shown by the study of electronic data interchange (EDI) adoption by small firms by Iacovou et al (1995). This study is very applicable to this research project as an EMR access system is a form of EDI, and general practice is composed of many very small organisations.

They found that three factors differentiated the ready adopter firms, the coerced adopter firms and the non-adopter firms - these were perceived benefits, organisational readiness, and external pressure to adopt. They found that the major reason for small companies to become EDI-capable was external pressure, especially from trading partners. This agrees with the major reason for GPs to adopt an EMR, that of external pressure from the current health reforms and from the development of IPAs (Walls 1989b; Tilyard et al 1991; Turnbull 1992; Britt and Miller 1993; GEHR 1993; McCormick and Boyd 1994; Central Regional Health Authority 1996a; Minister of Health 1996). The study also found that there

is additional need for financial, technological, and managerial assistance to increase the adoption of EDI by small organisations. The authors of the EDI study recommend three steps for EDI initiators, such as a secondary health care institution, to assist them in preparing their partner expansion plans (in this case GPs or other primary care health providers):

1. 'develop a long-term plan that covers the adoption of small partners from the very beginning'
2. assess the EDI preparedness status of each small partner
3. choose and implement an appropriate subsidy and influence strategy for each partner, involving financial and technological assistance, promotion efforts, and coercive tactics' (Iacovou et al 1995, pg 479).

In summary, the various variables that have been found to influence EUC success can be divided into intra-organisational variables, extra-organisational variables, and variables that influence the individual's use of the computer or application. The role of user acceptance and user participation is central to the user's attitude towards the computer/application and thus to EUC success.

The previous sections considered general end-user computing, measures of end-user computing success and potential variables for CSFs for general end-user computing. The objectives of this report is to identify the CSFs for GP access to an EMR, therefore the following section discusses the literature review on GP computing and their reactions to computerisation and towards electronic medical records.

3.2.4 GP computing and GP reaction to computerisation and EMRs

A survey of GPs views revealed that 63% of GPs commented that they were frustrated by difficulties liaising with hospital staff, and 8% of GPs' general comments were for improved communication with other health professionals (Walton and Romans-Clarkson 1990). This situation applies to secondary health care institutions where a study specifically investigating the primary-secondary care

interface between a secondary health care institution and GPs showed that 68% of GPs reported experiencing difficulties with acute referrals, and 76% with routine referrals (Stringer 1992). The same study reported that 94% of GPs wanted regular information on waiting lists, 97% wanted to be notified when a patient was discharged from the hospital and 50% felt that the time taken to send out discharge summaries was too long and that significant information was frequently omitted from the discharge summary (Stringer 1992). As it is proposed in this research project, that primary care-secondary care communication could be improved by the adoption of information technology, it is appropriate to consider how much, if any, computerisation exists amongst the GPs working in general practice in New Zealand.

Practice computerisation

On 30 June 1994, there were 2,730 general practitioners in New Zealand - 2,386 of them in full-time equivalent practice (Ministry of Health report 1994/5, cited in NZMA Newsletter 1996). The General Practitioner Workforce statistics for 1994, showed 2660 doctors working mainly as GPs in New Zealand (West 1994).

Klijakovic (1996) reporting on the RNZCGP database (1995) found that 69% of the 1014 responding GPs used a computer in their practice. Of these, 73% of the 799 responding GPs who gave details of their computer usage used a mixture of computers and manual records, 13% used manual practices only, and only 14% were fully computerised. With respect to clinical notes kept by manual or computerised general practices, he found that 50% manual only, 15% computer only, 2% computer and manual and 33% not used or not recorded.

The number of GP practices using computers is increasing. In 1989, 17% of practices used computers to some extent, with 30% of these practices using computerised clinical records (although the simultaneous use of paper records is not asked) (Walls 1989b). In 1990-1992, less than 44% of GP practices in Auckland, Waikato, and Taranaki were using computers, with 21% using a computerised record system (Gribben et al 1995). There were also regional

variations in the use of computers - 25% of Auckland GPs, 14% of Waikato urban GPs, 24% of Waikato rural GPs and 17% of Taranaki GPs who responded used computerised records. In 1995, 84% of 268 responding GPs from a random survey of 500 GPs, used a computer for at least one task, 26% used computerised clinical notes and 44% felt that keeping clinical notes should be computerised (Thakurdas et al 1996). In 1995 and 1996, two surveys by the RNZCGP recorded a 69% computerised practices with 15% using computerised clinical notes (RNZCGP database 1995; Klijakovic 1996), and ~78% computerised practice with ~25% using computerised clinical notes (RNZCGP database 1996).

Much of the existing computer capacity is unused as determined by the specific tasks carried out by computer. The tasks with the greatest potential for GP computerisation were: doctor education; automated checking for drug interactions/contraindications; patient education through multimedia; interfacing with laboratories; database enquiry of patients. With specific reference to computerised medical notes, only 26% of respondents used computerised medical records, and only 44% felt that this was a task that should be computerised. (Thakurdas et al 1996).

Thomson (1988), in a study of 23 computerised practices and 81 non-computerised practices in the Auckland area in 1984, found that a decision to computerise did not appear to be related to work load level, group or solo practice, or practice nurse use (Thomson 1988). However, more recent researchers found that the decision to computerise does appear to be related to practice size (Walls 1989b; Thakurdas et al 1996), and that one and two doctor practices are less likely to be computerised than larger GP practices. The reason for this difference may be that the drive for accounting and appointment systems has led larger practices to computerise whereas smaller practices have not found a need to computerise and that the average GP sees little financial incentive to computerise (Walls 1989b). However, the increased demand for statistical information by Area Health Boards (replaced by CHEs and RHAs and now by the Transitional Health Authority) will eventually drive smaller GP practices to computerise as well (Walls 1989b).

Respondents' RNZCGP membership status appeared predictive of task computerisation and computer use (Thomson 1988; Thakurdas et al 1996). Similarly, working in a high socio-economic area increased the likelihood to be computerised (Thomson 1988). Whereas, gender, year of graduation and membership on the Indicative GP Register were not statistically significant factors in determining attitudinal and behavioural responses (Thakurdas et al 1996).

On an international front, the level of computerisation varies from country to country. At the IMIA workshop on primary care computing in the UK in 1990, the attendees considered that the percentage of computerised practices in their respective countries ranged from 2% in Israel to 45% in the UK and Wales and upto 50% in Japan. It was felt that the high uptake of computerised practices in the UK was partly due to funding initiatives and partly due to compulsory patient registration (IMIA Workshop 1990).

In summary, there is a large variety in the access to, use of, and experience with, computerised technology in primary care. There are many reasons for these differences between access, use of, and experience with computers. The introduction of computers into general practice requires GPs to change some part of their practice, therefore it is appropriate at this stage to consider why GPs appear reluctant to make the changes needed to adopt computerisation in their practices.

Reluctance to change

There are many reasons why GPs are failing in the access to, use of, and experience with, computerised technology in primary care and are thus not adopting EMRs. GPs are conservatives and don't like change (GEHR 1993), may be reluctant to take on the time and effort to make learn a new skill or to make the change, or may even be apathetic towards any change in any direction (Foote 1990a; Turnbull 1992). They may not have the time to learn new skill or make changes (IMIA Workshop 1990). The attitude of GPs towards computerisation and the perceived disadvantages of computerisation may stop GPs from adopting

computers (IMIA Workshop 1990; Joshi 1991). Another reason is that doctors are concerned about the many recent changes associated with the health reforms, and may see the 'push' to change to computerisation to be a way of cost-cutting and not improving services. (Dopson 1994).

However, the attitude of GPs towards adopting computerisation is altering (Turnbull 1992). This alteration in the reaction of GPs to the adoption of computerisation, is shown by the increasing numbers of GPs who feel that computerisation is becoming a necessity, like the idea of computerisation, or feel comfortable using a computer, and by the increasing numbers of practices that are computerised (Gribben et al 1995; RNZCGP database 1995; RNZCGP database 1996; Thakurdas et al 1996).

The Select Committee in the House of Lords (1996), found that this trend is not confined to New Zealand. In the United Kingdom, over 90 per cent of GPs have computers in their surgeries and over half of those use computers in their consulting rooms. GPs are probably the largest single group of clinicians anywhere in the world who have found a practical benefit for patient care in the daily use of computers and information technology in the context of the consulting room. However, only a small percentage of these computers are currently connected to an external network, at least partly because of concern about the confidentiality of personal health records (House of Lords, 1996).

Armstrong, Reyburn and Jones (1996) describe a qualitative survey aimed at discovering what prompted 18 general practitioners in south London to change their prescribing habits over the previous six months. The authors identified three main patterns of change: accumulation, in which evidence to change gradually built up; challenge, in which a dramatic clinical event prompted the change; and continuity, in which a willingness to change was converted into action by a specific event. The lessons are that individual doctors respond to different types of cues; engineering a challenge may help; and that the change needs reinforcement. Armstrong et al (1996) suggest that change does not always occur from a rational consideration of the evidence placed before the doctor. This contrasts with

Winfield (1991) and Frenzel (1992) who suggest that change is a rational process, in which users take a comprehensive view of the pros and cons and then act accordingly.

The most important request made by doctors, other than sticking to their habits, was the time factor. If users are frustrated by the amount of time spent using a computer to perform a task or the amount of time correcting errors, they become dissatisfied. Thus, user satisfaction is the most important factor in ensuring the uptake of a technology (GEHR 1993).

However, there are additional factors that GPs must take into consideration before implementing change, especially in the adoption of computerisation to replace a paper-system which, despite having some limitations, has been tried and tested for many years. The doctor-patient relationship is very complex, and the factors that affect quality of care are numerous and diverse and go beyond the information recorded in the health record of an individual patient (Balint 1964). There are very few studies looking at the effect of computing on patient care and outcome, only three such studies were found and only one showed any improvement in patient outcome (Sullivan and Mitchell 1995).

Thus, GPs may not actually be reluctant to take on the time and effort to make the change to computerisation (Foote 1990a) but different GPs may require different cues and reasons for changing before doing so (GEHR 1993; Armstrong et al 1996). Importantly, GPs and other doctors do not like new ways and concepts being imposed on them from above, thus if changes to GP behaviour have to come, they have to be for the better, financially and quality-wise, and they have to be introduced by respected leaders in the profession (GEHR 1993).

What, then, may be some of these cues and reasons to change? Using the 'equity theory' (Joshi 1991) to increase GP computerisation, it would be necessary to reduce the perceived disadvantages of computerisation, or else increase the perceived advantages. Therefore, the advantage and disadvantages of GP computerisation will now be discussed.

Advantages of GP computerisation

There are benefits that will increase the likelihood of computer adoption amongst GPs (Walls 1989b) and even where there are disadvantages to using information technology, provided the advantages outweighed the disadvantages, GPs would be prepared to participate in its use (Watson 1996). This would suggest that if GPs can see an overall advantage in computerisation, they are not adverse to adopting the technology.

The advantages of GP computerisation can be divided into those of practice management and those of patient management.

Practice Management

Information technology can perform routine general practice tasks flawlessly, such as prescription and referral letter writing, patient recalls, accounting/billing and appointments, once set up right and given the right information (Walls 1989b; Holland 1996; Klijakovic 1996). In general, these benefits of information management by computerisation in primary care are in the quality of practice management rather than in providing monetary advantages (Holland 1996).

Information technology has also enabled the development of EMRs. As discussed in the section on EMR definition, the use of EMRs is proposed to provide a more complete patient medical record (IMIA Workshop 1990) and to be a solution to the problems of paper records by providing benefits of easier and quicker availability, transfer and retrieval; linkage; storage; data views; reporting and abstraction; quality and standards assessment; and decision support (Foote 1990b; Wyatt 1994; NZHIS 1995b; NZHIS 1996b).

Patient Management

Information technology in patient management appears to help in improving preventative care, management and co-ordination of health care, use of services, efficiency, satisfaction, access, and doctor performance but is less effective in

improving continuity of care, or patient outcome (Sullivan and Mitchell 1995; Yano et al 1995).

Disadvantages of GP computerisation

There are however, certain disadvantages to GP computerisation, which will now be discussed.

Cost

The disadvantages of GP computerisation can be discussed in terms of both patient and doctor resources (Holland 1996). The potential cost to patient resources is the risk of losing patient satisfaction, confidentiality of recorded information, trust, patient time, and money (Holland 1996). Whilst the use of computers within the consulting room indicated to patients that the GP was up to date (Thakurdas et al 1996), and increased the overall length of time of the consultation, patient-initiated and "social" conversation was decreased (GEHR 1993; Sullivan and Mitchell 1995). Many doctors believe that keeping clinical records on computers interferes with doctor-patient communication (Thakurdas et al 1996).

The doctor resources that are called upon in computerisation include personal resources to deal with the stress of change, the effort of learning a new skill, the potential embarrassment of miskeying and the time it takes to get used to a new method of information presentation. Computerisation can also be costly in terms of time, as the computer system will require inputting, maintenance and upgrading. The financial costs of computerisation can be considerable and include the cost of hardware, software, maintenance, mailboxes, materials such as printer ink and paper. Extra physical space and disc space may be needed to store the computer system and records and also to retain the manual records as only 14% of general practices are fully computerised. (Holland 1996; Klijakovic 1996). This financial cost can be a barrier to computerisation (Foote 1990a; IMIA Workshop 1990; Thakurdas et al 1996).

Watson (1996) in feedback from a pilot computer based education for rural GPs discovered that the perceived disadvantages included the initial cost of the technology, the initial learning curve to master the technology, and personal telecommunications costs. The lack of any financial return and the absence of any commercial benefit also account for the reluctance of GPs to computerise (IMIA Workshop 1990).

Interestingly, GPs do not appear to pass the cost of computerisation onto the patient, or at least not in the 1980s (Thomson 1988). GPs in computerised practices appeared to accept a lower increase in income instead (Thomson 1988).

There are factors other than personal cost which may prevent GP from adopting computerisation.

Security and confidentiality

Security and confidentiality of medical records, are a major area of concern for GPs (Walls 1989a; Foote 1990b; Kennedy-Grant 1991; Buchan and Paul 1992; Collins 1992; West 1992; NZMA Newsletter 1993; Townsend 1993; House of Lords 1996) and despite the current levels of security in existing computer systems, only 28% GPs feel that privacy issues regarding computerisation have been dealt with adequately (Thakurdas et al 1996). Adequate data storage, retrieval and exchange capabilities, data validation, encryption, and security are necessary (NZHIS 1995c; Purves 1996; Thakurdas et al 1996) along with access restrictions which will vary depending on the type of user and the nature of the use to which the data will be put (GEHR 1993). These measures need to be demonstrably effective before EMRs are acceptable, not only to GPs, but to other health professionals and to patients (GEHR 1993).

Concerns about confidentiality of personal health records are also limiting the connection of GP practices to external networks and hence restricting the sharing of information (House of Lords 1996).

Medico-legal concerns

The medico-legal concerns discussed in the earlier section on the use of information technology in health care apply to GPs (Pritchard et al 1984; Walls 1989a and 1989b; Campbell et al 1992; GEHR 1993; Townsend 1993; Health Information Privacy Code 1994). Thus, issues of confidentiality, ownership and copyright, liability and accountability, identification, durability, processing of personal data and transparency all need to be addressed regarding the use of EMRs by GPs (Walls 1989a; GEHR 1993; Purves 1996; St John 1997a).

The British Medical Association has identified the need to legitimise the computerised medical record as one of the main impediments to the adoption of EMRs by GPs. It has been part of the terms of service of GPs that they must make records on paper and the Department of Health, whilst agreeing with the significance of this legal constraint, said that "the major barrier in many places is the willingness of hospitals to allow it to happen" (House of Lords (1996). This situation is applicable to New Zealand where the legality of EMRs has not been proven (Question on electronic records 1996; St John 1997b).

Lack of demonstrable benefits in patient outcome

There are very few studies looking at the effect of computing on patient care and outcome and only one showed any improvement in patient outcome (Sullivan and Mitchell 1995). However, Donaldson (1996) considers that factors that have meaning for health care professionals and patients such as improved diagnosis, more appropriate and effective treatment, fewer complications, greater protection through preventative programmes, more decisions that adhere to evidence, and less inconvenience are more likely to lead to better and more widely accepted investment in computerisation.

Attitude towards computerisation and the use of EMRs

The NZHIS discusses that the obstacles to the successful adoption of EMRs relate more to people and practices than to technology. They consider that the main requirements for adopting an EMR are: confidence in computers, a positive

attitude to computers in the workplace, identifying the legitimate uses of clinical information, and a basic knowledge and understanding of the technology (NZHIS 1995b).

Computer anxiety is another barrier to computerisation and in a study of interns in the USA, Brown and Coney (1995) found factors that were predictive of anxiety about computer use included self-rated skills, typing ability, prior computer use, computer ownership, computer anxiety. They found that age, gender, and physician input of data were not predictive of computer anxiety or attitudes to computer use.

GEHR (1993) states that even today 50% of the medical profession are afraid of touching a computer keyboard. Dr Fawdry in IMIA Workshop (1990) states “there is a fear of IT. This fear, a personal and cultural fear, applies to GPs in this country (UK)” (pg 119 IMIA Workshop chapter 7.2 IT for development)

Technology problems

There are a variety of technological problems with the current use of computers and EMRs in general practice. These are discussed below.

Incompatibility of different information systems

There are at least 7 different practice management software systems that may incorporate EMRs in use in primary care in New Zealand (RNZCGP database 1996). There are practical differences between these GP systems and there is a lack of common shared standards. There is also different coding and disease classification systems used by primary and secondary care, including the ‘International Classification of Health Problems in Primary Care’ (ICHPPC-2), ‘The International Classification of Primary Care’ (ICPC2), both based on the ‘International Classification of Diseases’ (ICD-9), the ICPC-Plus system based on the ICPC system, the ‘READ Clinical code’ system, the ‘ATC Extension Code’ for pharmaceuticals (Jurd et al 1995; Ferguson 1996; Simon 1996b; Gardner 1997). This creates difficulties and delays in using computer systems to record and share

clinical information between general practice, secondary care and the health authorities (Pressley 1996). Not only needs there to be telecommunication standards but the medical data itself should be structured in such a way that it is transferable between different systems (GEHR 1993).

Lack of support and training

The biggest obstacle to any health care professional in taking true advantage of the current explosion in health information is training (GEHR 1993). This training is partly in how to use computers sensibly and safely and at the same time to minimise the disruption that computers will cause in the clinician-patient encounter. A major component of this is the skill required for good record-keeping, rarely taught well at undergraduate level and often ignored during higher professional education. The second level of training would be how to make better use of new information being presented about patients which has hitherto not been available to them. The training of general practitioners in how to interpret x-rays, and the training of other professionals to interpret their own favourite datatypes is bound to increase the future demand for them (GEHR 1993). The provision of computer training needs to start with medical students (GEHR 1993).

With regard to training, Thakurdas et al (1996) found that only 47% of respondent GPs felt that they had sufficient information on computerisation. The same study showed that only 42% of respondent GPs felt that the level of ongoing software support was adequate, 43% felt that ongoing hardware support was adequate but 27% were unsatisfied with their software and 13% with their hardware.

Lack of user-friendliness

The development of user-friendly software will increase the adoption of GP computerisation (Walls 1989b; Foote 1990a; IMIA Workshop 1990; GEHR 1993). Most GPs could not care less how transmissions are made and they do not want to be bothered by complicated procedures. If their work implies communicating electronically, it should be easy and not time-consuming (GEHR 1993).

Direct data entry at time of patient consultation by the health professional is considered highly desirable for the use of EMRs. However, not all health professionals performed the data entry, preferring to use data entry forms which were later entered by clerical staff. This results in a variety of problems - illegible forms led to transcription errors, time lag between patient encounter and data entry, delay in entering laboratory results, incomplete patient record at the time of the encounter, added cost of clerical staff. This can be overcome by encouraging clinicians to use the computer in the consultation, improving data entry interfaces, and improving the benefits of computerisation to the clinician (IMIA Workshop 1990).

Many GPs perceived that keeping clinical records on the computer was tedious and interfered with doctor-patient communication, especially those who were not comfortable using a computer. Many GPs stated that they found entering diagrams into computerised notes difficult (Thakurdas et al 1996). Thus EMRs must be able to accommodate both highly structured methods of recording information and very informal methods of recording information including the use of drawings and diagrams (GEHR 1993). The ability to accommodate individual expression and creativity within the EMR is seen as fundamental in some areas of medicine, especially in specialities where narrative style records are the norm, such as psychiatry (GEHR 1993; Purves 1996). The development of an EMR which can faithfully record and support the provision of clinical care, in a way that the health worker finds appealing, and which encourages and demonstrates clinical competence will increase the adoption of an EMR (GEHR 1993).

Data concerns

As well as the issues regarding confidentiality, security, ownership and copyright, liability and accountability, identification, durability, processing of personal data and transparency (Walls 1989a; GEHR 1993; Townsend 1993), the data needs to be up to date (Purves 1996). If there is to be a single shared institutional or district clinical record, users at a local site must always be working from a copy of the most up-to-date record available. Any changes they make must be transmitted back to that source immediately. Clinicians must be aware of the institution whose records are being accessed, and of the named parties responsible for the backup and data protection processes. The original author of a transaction should have responsibility for keeping it (GEHR 1993).

An additional problem with EMRs, is that despite an EMR containing more structure than manual records, it has less content than the paper record (GEHR 1993). The level of agreement between the initial user and a subsequent reader regarding a diagnosis based on the content of the medical record was lowest for EMRs, thus the 'usability' score was lower than for a paper record (GEHR 1993).

Concerns regarding the uses of data in an EMR

Electronic medical records can be used in patient management, health care prevention, clinical research and epidemiology, education, clinical audit, and health services management and contract management (IMIA Workshop 1990; GEHR 1993; Wyatt 1994; NZHIS 1996b) and need to be capable of supporting practice in all of the areas defined as components of clinical competence, including self directed learning, self evaluation and quality assurance (GEHR 1993). The use of medical records by non-clinicians is a major area of concern for GPs (Kennedy-Grant 1991; Buchan and Paul 1992; West 1992; GEHR 1993; House of Lords 1996).

The NZHIS (1995b) consider that one of main requirements for adopting an EMR was to identify the legitimate uses of clinical information. This requirement is shared by GPs who would be reluctant to release patient or practice information

without both an acknowledgement of their efforts (including cost) and reassurances regarding the uses of the information (Thakurdas et al 1996).

Overcoming the barriers to computerisation

Evidence is amassing that these disadvantages and barriers to computerisation can be overcome. Since the response that the computer interfered with doctor-patient communication was related to discomfort using a computer, the perception that the amount of time involved with computerisation was too great, and dislike for computerisation (Thakurdas et al 1996), altering these will decrease the perception of interference with the doctor-patient communication and hence eliminate one of the barriers to computerisation. Providing a more user-friendly interface, better vendor support, and increasing the advantages of computerisation such as providing the ability to link with laboratories for results and to medical databases will increase the adoption of computerisation (Walls 1989b).

Increasing the political and financial pressures and providing increased financial resources) has been the main driving forces in the UK leading to the belief that computerisation was “a necessary part of survival” and increasing the rate of uptake of IT in the health service (IMIA Workshop 1990 pg 143 chapter 9; House of Lords 1996). These financial incentives and functional inducements have increased the use of computers in the UK to >70% of general practices (Miller and Britt 1993). The financial incentives ranged from ‘free computers’ to ‘computer subsidies’ of upto 50% in return for using certain computer systems or becoming a fund-holding practice. The functional inducements included making administrative requirements such that computerisation was essential or highly advantageous - such as computerised prescriptions; financial incentives to meet certain health screening targets which required data systems to accomplish; fund-holding; and highlighting the advantages of computerised clinical notes including drug interaction information, recall systems, modem access to medical databases, direct transfer of pathology results (Miller and Britt 1993). The NHS is using a strategy of standards development, pilot projects and positive incentives for compliance as the basis of the NHS-health reforms in the UK (Miller and Britt 1993).

Summary of GP computing

In summary, therefore, ways to reduce the disadvantages for computerisation for GPs would be to reduce the pressure and reduce the paperwork and administrative workload of GPs, improve the seamlessness of patient care, meet the needs for and the transference of information, provide protection against litigation, assist in audit, ensure security, integrity, documentation, and accountability, increase the user-friendliness of the computer tools, have patient support and consent, and address the issues of cost (Walls 1989a; Kennedy-Grant 1991; Tilyard 1991; Buchan and Paul 1992; Isaac 1993; Dukes and Stewart 1994; Guise, Huber, Guise, Brown, Bankowitz, and Hunt 1995). However, the belief by 56% of GP respondents that clinical notes should not be computerised, combined with a perception that computers interfere with doctor-patient communication, that there are still concerns about security and privacy and that many GPs still feel uncomfortable using a computer (Thakurdas et al 1996) does not indicate well for the widespread rapid adoption of an EMR by GPs in the near future.

3.2.5 GP requirements for accessing an EMR

There is limited published information regarding the particular concerns and problems with GP access to an EMR held by another organisation, basically because the widespread adoption of EMRs and of information networks is limited. The major points from the primary health care information networks that do exist within New Zealand are highlighted below. They demonstrate that the successful implementation of an information network goes way beyond the basic requirements of information transfer, such as the physical linkage, technology and data compatibility, and security.

Tilyard et al (1991) in a study on the health services utilisation of a general practice population found that the physical establishment of the link between general practice and secondary care was a relatively minor matter, the motivation and will to actually do so was more significant in the success of such a link.

Simon (1996a) discusses the factors needed for success in the new health environment of a primary care network:

- the development of effective generalist care teams
- the development of innovative relationships with our community
- the assessment of needs, targeting services and producing measurable outcomes in the context of meaningful measurement
- the development of balanced and clear relationships with management
- the development of realistic relationships with the purchasers of health care.

Kljakovic, Seddon, Reinken, and McLeod (1992) have advice for future general practice information networks:

- “have GPs in the planning stage
- publicise the aims of the network to the participants in the network, the funders, and the potential users of the information
- always have a personal approach when recruiting general practitioners
- employ enough competent clerical staff
- have one body controlling the funds and giving adequate cash flow
- realise that information is costly and quality information takes time (in years) to obtain in general practice”.

Tilyard (1991) discusses the requirements for enrolment of GPs onto a computerised network and summarises the findings as:

- enthusiasm to contribute to the body of knowledge about general practice
- commitment to record and report accurate data about patients
- computer literacy was not a requirement
- willingness to learn the necessary computer skills to carry out the practice
- commitment to ensure that both patient and doctor confidentiality is protected

In summary, again it is the people and policy issues that are more important than the technology issues with regard to GP access to EMRs.

3.2.6 Effects of non-GPs on GP access to EMR

There are a variety of medical and non-medical organisations and other service providers with which GPs communicate (CRHA 1996; Simon 1996a). It is possible that any of these organisations and providers may impact on the successful application of a GP EMR access system. For example, as is currently happening, the New Zealand Medical Association (NZMA) and the New Zealand General practitioners Association (NZGPA) are advising all Lead Maternity Carers (LMCs) GPs not to accept the new section 51 maternity contract (NZMA Newsletter 1995; Sijnja 1996) and many GPs are following their advice. If an organisation such as the NZMA, the NZGPA, the RNZCGP, or their IPA, were to recommend that GP LMCs were to refuse to use the IS system installed by the secondary health care institution then if the GPs followed the advice, the EMR access by GP LMCs would be a failure. The NHS in the UK has run into such a situation, where GPs have refused to use the proposed NHS network because of the perceived lack of security of the network (Anderson 1995a; Anderson 1995b; Beecham and Smith 1995; Beecham 1995a; Beecham 1995b; Anderson 1996; Sellu 1996).

GPs in New Zealand will be similarly affected if they are asked to participate in an information system that they feel impinges on standards of patient care, or that does not comply with government legislation such as the Health Information Privacy Code 1994, the Code of Health and Disabilities Services Consumers' Rights 1996, or professional ethics and codes of conduct as delineated by professionals bodies such as the RNZCGP, NZMA, Medical Council of New Zealand or if patients refuse their consent for their medical information to be included in the EMR (Dowling 1989b; Collins 1992; West 1992; Fisher 1993; Townsend 1993).

Individuals' concerns about organisational information privacy practices, including the privacy of computer databases, are related to the collection, internal unauthorised secondary use, external unauthorised secondary use, and improper access to personal information as well as errors in personal information, plus

concerns relating to reduced judgement in decision making and combining data from several sources. (Culnan 1993; Smith, Milberg and Burke 1996). These concerns are expressed by patients regarding their health information (Hill 1997) and it seems logical that patients and primary health care professionals would have similar concerns about the information privacy practices of a large secondary health care institution holding personal and clinical patient details, such as a large hospital. These aspects are acknowledged by this research project as having prime importance on the success of an EMR access system and relate directly to user acceptance.

3.2.7 Identification of CSFs for GP computing and EMRs

The previous sections discussed the potential variables identified in the literature review which may influence GP computing and EMRs. By combining these variables, a list of proposed variables can be obtained. However, there are problems with combining variables from multiple sources and studies of MIS research. There is a great deal of variation in findings across studies of information technology in organisations such that there are very few generalisations for which it was not possible to cite a number of counter findings (Kraemer and Dutton 1991). All information systems are not alike, hence it is difficult to compare across studies as most studies are unclear about the specific technology used, and there is 'no widely accepted taxonomy of information systems for comparing findings across studies' (Kraemer and Dutton 1991, p16). Additional sources of variation in the findings of different studies are the rapid pace of change of IT, or methodological differences in sampling, measurement or analysis (Kraemer and Dutton 1991).

However, whilst acknowledging that it is difficult to combine variables from different research studies for the above reasons, by comparing the variables identified from the literature review of EUC, GP computing and EMRs, a list of proposed CSFs can be developed. These are summarised in table 1. These variables will form the basis for the initial research hypotheses which are developed further in the research approach stage of this research project detailed in the next chapter.

Generic variables for EUC success	GP computing variables	EMR variables
<ul style="list-style-type: none"> • Internal support • Internal training • External training • Management support • External support • Environmental set-up (facilitating conditions for use) • Perception of user-friendliness of software tools • User attitude/acceptance • Goal definition and realisation • Perceived utility • User participation • Computer anxiety • Demographics (age, gender, organisational level, education) • Value attainment • Cognitive issues • Motivational issues • Social factors • Tool access/availability • Corporate policies • Needs analysis • Complete documentation • Change management 	<ul style="list-style-type: none"> • user participation • user acceptance • perceived utility of the system <ul style="list-style-type: none"> • needs targeted • improve communication and information sharing • decrease GP pressure/paperwork • improve seamlessness of care • protection against litigation • increased ease of audit • accountability • improved quality of patient care • less inconvenience • accurate, factual, easily retrievable, secure from loss • minimal disadvantages <ul style="list-style-type: none"> • financial cost • personal time/resources • personal stress • physical space • learning new skills • realistic expectations and relationships • patient consent • confidentiality/security • user-friendly system • access and availability • personal approach to GPs • training and support 	<ul style="list-style-type: none"> • user acceptance • user participation • introduced by respected leaders of the profession • permit individuality and autonomy • security/confidentiality • legitimacy • commitment • easy to use • not time-consuming • perceived utility <ul style="list-style-type: none"> • financial benefits • improved quality of patient care • minimal cost • efficiency • computer anxiety • accuracy of data • integrity of data • contemporaneous data • provide education • support measures of competency <ul style="list-style-type: none"> • audit • accountability • continued medical education • quality assurance • training • ownership, copyright, liability, identification, durability, processing of personal data and transparency • transferable amongst different systems

Table 1: List of potential critical success factors.

Summary of Chapter Three

In summary, this chapter details the results of the literature review for the use of EMRs by health care professionals, health care institutions, and primary care. The variables that may be critical success factors for EMR access systems have been discussed and summarised in table 1. The concept of end-user computing has been introduced, the definition of end-user computing success discussed, and the location of the critical success factors identified.

The focus of this research project is on the human factor issues, data and database issues and political, cultural, and policy issues relating to the planning, implementation and operation of GP EUC. The factors may also include the area of telecommunications. The factors investigated will lie within the areas of the medical profession, the individual GP, the secondary health care institution and the rapid evolution of information technology within both the organisation, the medical profession and the general community (time-dependent areas).

The success measures of system use, system utilisation, and EUC satisfaction were selected by this research project as they are commonly used, have been validated to at least some extent, have existing measurement scales, have been applied to small firms, have a theoretical foundation and fit the objectives of the project.

The various variables that have been found to influence EUC success can be divided into intra-organisational variables, extra-organisational variables, and variables that influence the individual's use of the computer or application. The role of user acceptance and user participation is central to the user's attitude towards the computer/application and thus to EUC success.

Chapter Four - Research Approach

This chapter identifies the research area, locates relevant theories for a model of EMR access systems, develops the research model, and delineates the hypotheses that will be the basis of the primary care survey. It takes the variables proposed by the literature review in Chapter Three and integrates them into the initial theoretical research model to develop the proposed theoretical model for EMR access systems that will form the basis for the primary care survey discussed in Chapter Five.

4.1 An argument for rigour

There are a variety of problems that exist with IS research that relate to poor research design and data analysis. These include finding answers to questions that no-one cares about, failing to use theory to guide investigation, poor theory development, poor models of inquiry, weak hypotheses, missing factors in analyses, mistaken assumptions of representativeness of samples, not meeting the objectives of the research, producing statistically invalid results, and results that leave the investigator more confused than before (King 1991; Lucas 1991a; Moore and Benbasat 1991; Statistics New Zealand 1995). These problems stem from a lack of research planning and research question definition (Lucas 1991a; Porter 1991 and King 1991) and a poorly done survey is a waste or both the respondents' and the researchers' time (Gutek 1991a). Thus research planning will result in better quality research designs that will focus on key issues and guide effective and useful data collection (Attewell and Rule 1991; Danziger and Kraemer 1991; Gutek 1991b; Lucas 1991a).

Research planning itself involves a number of steps: the investigation of a research topic that is relevant, the definition of a good research question, basing the research on a relevant theory, and then using the theory to develop a set of testable hypotheses (Lucas 1991b; Porter 1991; Polgar and Thomas 1995). A good research question is one that is important, interesting and at the least, researchable, if not always completely answerable (Howie 1979; Porter 1991). However, the

definition of a good research question can be difficult, and requires early thinking in the research process for proper identification (Porter 1991).

There are some additional concerns that impact on the research planning process, in particular, the ethical issues and resource constraints. These define the scope and form of the investigation by impacting on the research question, the model used and the hypotheses developed and hence need to be resolved before the research project is fully committed (Sieber 1982; Polgar and Thomas 1995).

4.1.1 ethical considerations

The ethical issues are to ensure that no harm might occur to participants in the research project (Polgar and Thomas 1995). Thus they can affect any stage in the research planning process. Situations that require ethical guidance in research design include consideration of the use of deception, of researcher misrepresentation of the aims of the study, the violation of individual's privacy, and need to consider how does one observe and intervene in the lives of others without inflicting harm or wronging others but still obtain valid results, issues of who benefits, informed consent, protection of participants, minimising discomfort, community values. Issues in the area of sample selection include the conservation of resources of the researchers, subjects and the community; and in the area of data analysis, to report accurately (Sieber 1982; Polgar and Thomas 1995). There is both an ethical obligation and legislative requirements on researchers to remain objective and to respect the privacy of those who are being studied (Howie 1979; Sieber 1982).

The National Commission for the Protection of Human Subjects of Biomedical and Behavioural Research (1978) considers that the principles of beneficence, respect and justice should be the values that guide human research and form the basis to meet all obligations without invalidating the study findings (Sieber 1982). To this end, the National Commission identified six values that encompassed these principles - a valid research design, competent researcher, consequences identification, sound subject selection with the population that will benefit from the

research being the same as that from which the subjects are drawn, voluntary informed consent, and compensation for injury (Sieber 1982). This supports the argument for a planned research process.

In order to meet the ethical obligation and legislative requirements, this study went before two ethics committees, the Human Ethics Committee of Massey University and the Central Regional Health Authority Wellington Ethics Committee (CRHA Wellington Ethics Committee 1994; Massey University 1994).

Another ethical concern is that there is a choice of goals that the researcher can pursue with any project, and that the definition of the initial problem will depend on the researcher's perspective (Sieber 1982). Solutions include consultation with the people who have the problem in order to define it, empowering those persons to help create the solution and determining the goals of the persons they seek to study (Sieber 1982). In order to address these concerns, this research project was discussed, not only with academic staff of Massey University, but with the staff of various primary and secondary health care institutions and organisations, and with several GP obstetricians. A pilot study was conducted to test and validate the survey instrument and to elicit any other information or concerns from the target population.

However, involving members of an organisation as potential respondents has its own ethical problems. Individual organisational members cannot be approached as independent individuals as they exist in a hierarchical framework of rights and responsibilities. Also the researcher may have limited power to control the resolution of ethical issues in the organisation as the organisation may be more powerful (Sieber 1982). To that end, it was negotiated with both the primary and secondary healthcare organisations and institutions involved in this research project that the individual respondent replies would not under any circumstances be made available to the organisations, and the respondents were assured of that privacy. The questionnaires were also coded by number and not by name so that the organisations could not determine who belonged to each code number. The researcher was the only person with the key to the code and they were not an

employee of either organisation, and neither organisation had the power to force access to that key. The respondent's participation was also not a criteria of membership of the organisation and the organisation could not force anyone to reply, thus ensuring voluntary consent, confidentiality and privacy despite the existence of any contracts between the potential respondent and the organisations. This research project also uses survey research as its underlying methodology, for reasons that are discussed in Chapter Five. Survey research creates a situation where the respondent has a greater amount of power than in experimental research. They have a greater ability to refuse to participate, can end the interview, or can throw away the questionnaire, thus informed consent is not the major issue, rather privacy and confidentiality are the major issues (Sieber 1982).

Thus, using the role theory discussed by Mirvis and Seashore in Sieber (1982 p82), there was careful exploration of the roles of the researcher and of the potential respondents in the implementation of the research project and the resolution of any role conflicts that had been identified. This follows the general strategy discussed by Mirvis and Seashore in Sieber (1982 p93) to resolve the potential ethical issues in organisational research - initial efforts to define roles, early attempts to clarify roles and to reach agreements defining the interest of the various parties involved along with their role responsibilities, anticipating possible sources of role conflict and responding to them through policies and decision making procedures, and finally, providing for the resolution of remaining conflicts through collaborative effort, review of research relationships, and continuous legitimisation of the technical basis of the research.

4.1.2 economic considerations

Economic considerations are the second major group of considerations in ethical research and include the availability of participants, availability of equipment, availability of expertise, and the availability of time (Polgar and Thomas 1995).

The researcher must endeavour to end up with realistic data collection procedures which can be supported by the available resources (Polgar and Thomas 1995).

Economic considerations also impact on the variables selected from the theoretical

model for testing as the researcher needs to consider the cost and ease of acquisition, accuracy, and whether the variable can be controlled by management (Gurbaxani and Mendelson 1991).

The restrictions and subsequent limitations placed on this research project have been discussed in chapter 2. The limitations placed on variable selection will be discussed later in chapter 5.

4.2 Research area

As discussed in section 4.1 above, the formulation of a good research question is central to the research planning process. The literature review is both a summary and a critical evaluation of previous research and theory relevant to the problem under consideration and assists in the formulation of the research question. It justifies the need for further empirical evidence by identifying 'gaps' in existing knowledge (Polgar and Thomas 1995 p25). The literature review regarding EMRs suggests that the area of EMRs is attracting a large amount of attention in the strategic planning of health care, and is therefore appropriate to be considered as a research area. The literature review regarding theory relevant to the development of a model for CSFs for EMR record access systems is discussed in the next section.

4.3 Theory development for EMR access systems

As discussed in chapter 4.1, a research plan bases the research project on a relevant theory, and then uses the theory to develop a set of testable hypotheses thus improving the quality of the research design and data analysis (Lucas 1991b; Porter 1991; Polgar and Thomas 1995). Lacking a firm theory makes it difficult to come up with hypotheses, and that even when present, these hypotheses may not capture the major relationships amongst the variables under study, or may become tautologies that are untestable (Gurbaxani and Mendelson 1991; Lucas 1991b). However, the theory must be linked to the real world in order for model

development and variable selection to result in meaningful interpretation of the study results for the users (Eveland 1991; Gurbaxani and Mendelson 1991).

Thus, theory development should result in better instruments, clearer construct development, more effective operational definitions and techniques, identification of the domain and characteristics of the sample population and the unit of analysis, and make possible the use of construct related evidence for validation and of statistical analysis techniques such as confirmatory factor analysis (Alwin 1977; Benbasat 1991; Danziger and Kraemer 1991; Mason 1991). Thompson et al (1991) discuss that the lack of a theoretical basis provides a potential reason for the mixed empirical support for the hypothesis that attitudes influence computer use. Zmud and Boynton (1991) discuss that 51% of the manuscripts rejected by Daft for publication in the Administrative Science Quarterly (1985) were rejected because of inadequate theory and 24% for inadequate definition with theory. There are many dimensions used in MIS research to investigate information technologies - such as managerial control, computer utilisation, hardware complexity, infrastructure for supporting computers and computer use, etc, it is impossible to measure them all in one study, so a good theoretical foundation will help select which dimensions to use in any particular study (Kling 1991).

Furthermore, given the ever-present danger of "researcher bias", "data fishing" expeditions that produce statistically significant results without an underlying set of theoretically based hypotheses should be interpreted with caution (Gurbaxani and Mendelson 1991).

Thus, this research project sought to identify an appropriate theory on which to base the subsequent survey.

However, the IS field is broad and interdisciplinary, and lacks a central, unifying, broadly-accepted theoretical paradigm or even a coherent body of agreed-upon variables (Eveland 1991; Gurbaxani and Mendelson 1991; King 1991; Kraemer and Dutton 1991; Lucas 1991a; Mason 1991). The use of organisational behaviour and organisational theory is recommended by Zmud and Boynton (1991) whereas

Webster and Martocchio (1992) and Lucas (1991b) discuss that much of IS research is behavioural rather than technical, and that drawing theories from the field of behavioural science rather than becoming part of behavioural science is appropriate for MIS research. The use of behavioural theory in MIS research is also supported by Burton, Chen, Grover, and Stewart (1993) who discuss how behavioural theories indicate that it is necessary to evaluate behavioural intention or users' motivation to use the system in order to predict system success before actual implementation. Thus, the use of an existing behavioural theory would be justified for this research project.

There are problems, however, with using existing theories. They may have been developed for one context and relying on them exclusively to generate meaningful conclusions outside of that specific behavioural context may misguide the researcher (Eveland 1991; Lucas 1991b). There is scarcity of published data from which to develop such formal theories (Gurbaxani and Mendelson 1991), and there is limited assessment of the quality of such data that is available (Attewell and Rule 1991). The rapidly changing nature of MIS field makes developing a comprehensive theory more difficult (Mason 1991) as the technology present at the end of the research survey project may not have been in usage or even in existence at the start of the project (Mason 1991), IS is becoming more diffuse (Mason 1991), and there are major theoretical problems in conceptualising information technology (Attewell and Rule 1991; Kling 1991).

One solution to these problems is to borrow, integrate and develop theories from a number of different fields or "develop one's own research model inductively, based on existing studies" (Lucas 1991b pg 275). To that end, the literature was thus searched to identify a suitable theory, or to identify a theory that could be modified, to serve as the underlying theoretical basis for the subsequent survey research.

4.4 Theoretical model development

Many theories were identified in the literature review including but not limited to: Nolan's Stages of Growth (Cragg and King 1993); Expectancy Theory (Burton et al 1993); Theory of Reasoned Action (TRA) (Fishbein and Azjen 1975; Burton et al 1993; Davis et al 1989; Thompson et al 1991); Theory of Planned Behaviour (Mathieson 1991); Triandis' theory (Thompson et al 1991); Action Science (Levine and Rossmore 1993); Organisational behaviour - participative decision making and planned organisational change (Ives and Olson 1984); Critical mass (Rogers 1991); and the Theory of innovation diffusion (Moore and Benbasat 1991).

Many of these theories lead to the development of, were based on, or modified, an underlying theoretical model of which the Technology Acceptance Model (TAM) was the most common (Davis et al 1989; Moore and Benbasat 1991; Thompson et al 1991; Burton et al 1993; Igbaria et al 1995).

4.4.1 Initial theoretical model

General practice is a small business consisting on average of 10 people - 3 GPs and 7 staff (practice nurses, receptionists, practice managers and other staff) (Gribben et al 1995; RNZCGP databases 1995 and 1996; Klijakovic 1996) and between 20-24% of GPs work in solo practices with only 1 or 2 staff (RNZCGP databases 1995 and 1996; Klijakovic 1996; Thakurdas et al 1996). It is therefore, important to select a theoretical model that has validity for small businesses (Zinatelli 1994).

One of the few studies looking at EUC success factors for small firms was conducted by Zinatelli (1994). She developed a research model based on the TAM model, using a literature review and case studies of 8 small firms in New Zealand. Her model used system use, system utilisation, and EUC satisfaction as the criteria for measuring EUC success. The firms sampled in her study had between 20 and 50 employees, with one firm having only 12 employees. Thus, she used the same surrogate measures of EUC success as is proposed in this research project. The

Technical Acceptance Model was therefore examined in more detail to see if it would serve as the basis of an theoretical model for this research project.

The Technical Acceptance Model (TAM) was introduced by Davis in 1986 to predict computer usage behaviour (Davis et al 1989; Mathieson 1991; Zinatelli 1994). It proposes that perceived usefulness and perceived ease of use are fundamental determinants of EUC success by influencing behavioural intention which in turn predicts actual system use (Davis et al 1989; Mathieson 1991; Zinatelli 1994). TAM is an appropriate model for this research project as it is based on accepted behavioural theories (Theory of Reasoned Action), is related to the Triandis model and forms the basis of the innovation diffusion model (Davis et al 1989; Moore and Benbasat 1991; Thompson et al 1991; Burton et al 1993). It can be applied in a variety of diverse user contexts (Mathieson 1991). The model and the scales used have been successfully replicated by Davis (1989) and many researchers in different IS settings, including in both large and small businesses in different industrial settings (Davis et al 1989; Mathieson 1991; Moore and Benbasat 1991; Adams et al 1992; Zinatelli 1994). This increases the validity of the model and its measures. It is a research model that can show diagrammatically, the relationships between the different variables in an uncomplex manner, such that the omission of an important variable, especially confounding variables, may be reduced (Lucas 1991b).

It was therefore decided that the TAM would be applied to this special group of small firms - that of general practice.

System use, system utilisation, and EUC satisfaction have already been selected as measures of EUC success (c.f. Chapter 3). It is acknowledged that these are surrogate measures of success and may not be true indicators of success (Ives and Olson 1984).

User acceptance is a CSF for EUC in general in it's own right (Gogan 1984; Ives and Olson 1984; Cheney et al 1986; Nelson and Cheney 1987; Rivard and Huff 1988, cited in Pomare 1992; Doll and Torkzadeh 1988, 1989; Danziger and

Kraemer 1991; Winfield 1991; Kivijardi and Zmud 1993; Zinatelli 1994). The literature review highlighted that GPs may refuse to use an EMR despite the perceived ease-of-use and perceived usefulness of the EMR, hence user acceptance is important for GPs (Foote 1990a; Turnbull 1992; West 1992; Culnan 1993; Fisher 1993; GEHR 1993; Balint 1994; Dopson 1994; Anderson 1995a; Beecham and Smith 1995; Beecham 1995a; Beecham 1995b; Anderson 1996; Armstrong et al 1996; House of Lords 1996; Sellu 1996; Smith et al 1996; Thakurdas et al 1996).

It is therefore proposed in this research project that user acceptance be considered a separate CSF and hence be added to the model. It is proposed that user acceptance is related to perceived ease-of-use and to perceived usefulness and directly to EUC success. An initial theoretical model for EUC of EMR access systems based on the modified TAM is therefore developed with user acceptance, perceived ease-of-use and perceived usefulness as the main factors affecting EUC success of an EMR access system.

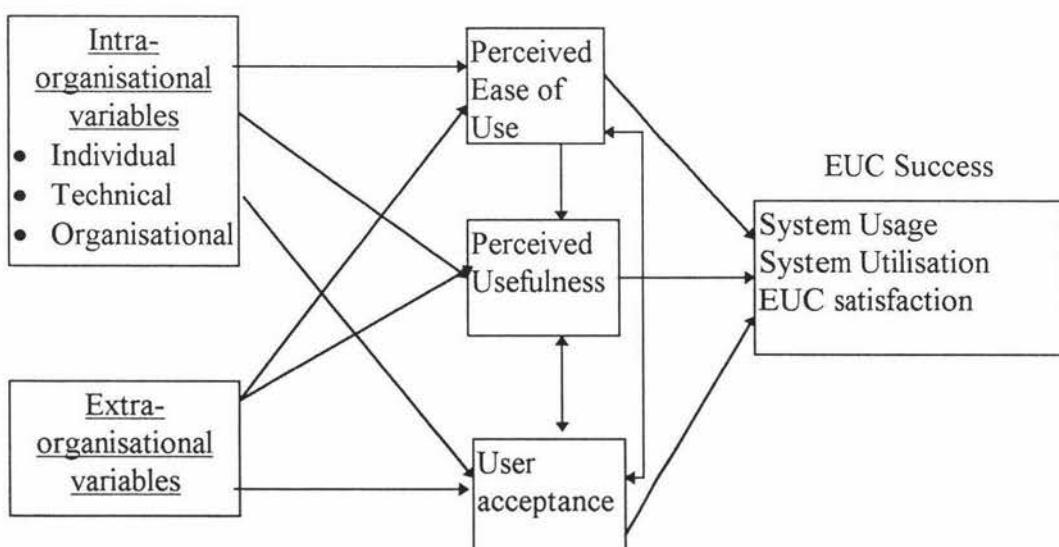


Figure 1: Initial Theoretical Research Model.

4.4.2 Initial hypotheses

Having developed an initial theoretical model based on the Technology Acceptance Model, the next step was to develop the initial hypotheses based on the variables identified from the literature review (chapter 3).

The initial hypotheses are therefore:

Hypothesis 1:

User acceptance is directly related EUC success and indirectly through perceived ease-of-use and to perceived usefulness.

Hypothesis 2:

Intra-organisational variables are directly related to user acceptance, perceived ease of use and perceived usefulness

Hypothesis 3:

Extra-organisational variables are directly related to user acceptance, perceived ease of use and perceived usefulness

4.4.3 Final hypotheses

The next task undertaken was to redefine the initial hypotheses and the theoretical model of critical success factors for electronic medical records access systems to develop the final conceptual model and hypotheses that will be studied by the primary care survey.

Howie (1979) discusses that the greater the number of the variables studied, the more complex the study, which adversely affects the quality of the data collected. There is no unique “best” set of variables, the process of selecting variables is subjective, and it is not be possible to prove that any procedure will invariably yield such a set (Gurbaxani and Mendelson 1991). The choice of the “best” set of independent variables depends on the purpose of the analysis (Gurbaxani and

Mendelson 1991). In many cases, the number of potential explanatory variables is very large and the problem becomes one of shortening the list. The variables measured should be those major or potentially useful variables whose relevance as a causal or explanatory factor is identified by an existing theory or hypotheses (Howie 1979; Gurbaxani and Mendelson 1991). Other considerations include the cost and ease of acquisition, accuracy, and whether the variable can be controlled by management (Gurbaxani and Mendelson 1991). Thus, the urge to record every conceivable variable should be resisted (Howie 1979).

Bearing these words of caution in mind, therefore, the combined lists of potential variables identified in Table One of Chapter Three were examined for inclusion in the final theoretical model. By comparing the lists, it is possible to extract those variables common to all lists, or considered critical by medical computer users and then hypothesise that these are going to be CSFs for GP EMR access systems.

User participation and user acceptance

All lists have user participation and user acceptance as critical factors of success and the relationship between user acceptance, user participation and user resistance has already been discussed. A personal approach to GPs can decrease their resistance and is recommended in both the GP computing and EMR lists. The placing of user participation as a variable affecting intervening variables such as user acceptance rather than directly affecting EUC success supported by other researchers (Ives and Olson 1984; Barki and Hartwick 1994; McKeen et al 1994).

Perceived utility (usefulness)

All lists have perceived utility as a CSF. Perceived utility (usefulness) of the system is related to goal definition and realisation, meeting one's needs, and value attainment in studies of large and small firms. Perceived system utility amongst GPs includes goal definition and realisation, needs targeted, value attainment by improved communication and information sharing, improved quality and seamlessness of patient care, and protection against litigation. The ability of the

computer system to store data in an easily retrievable, accurate, secure and factual manner can reduce the administrative workload and pressure.

User-friendliness

All lists consider system user-friendliness necessary so it will be proposed as a CSF.

Computer Training and Computer Experience

Computer anxiety reduces computer acceptance, and computer anxiety has been related to self-rated skills, typing ability, prior computer use and computer ownership. Many GPs have limited computer experience, hence increasing GPs' computer experience should decrease computer anxiety and hence increase user acceptance. One way to increase computer experience is to provide training. One of the disadvantages listed by GPs to computerisation was the time taken and increased stress in learning new skills, and the embarrassment of making mistakes. Training can also assist in minimising these. In Zinatelli's study of small firms, she found that external and organisational internal training was related to perceived usefulness, ease of use and system usage (Zinatelli 1994). Following the same logic, training will also increase GPs' perceived utility, user acceptance, ease of use, and system usage. Hence, it is proposed in this research project that external and organisational internal training and computer experience are CSFs.

External support

External support has been listed as CSF for generic EUC by increasing the perceived ease of use, and system usage. As these are also considered CSF for GP EUC, this research project will include external support as proposed CSFs.

Internal support and Management support

Organisational internal support and corporate policies such as management support assist in forming realistic expectations and relationships between all parties. Hence these are proposed as CSFs.

Access and availability

Access to and availability of the computer system or a specific application is present in all lists and hence will be considered a CSF. However, the type and degree of access to the data contained within an EMR needs to be established.

Technical issues

Flexibility of use permitting individuality and autonomy and compatibility across systems is essential for EMR usage.

Personal cost

Financial, time and personal costs are of major importance to GPs affecting both the adoption of computerisation and EMRs.

Medico-legal, security, confidentiality and data issues

There are some specific variables that are specific to GP computing and EMRs that need to be considered. These are patient consent, confidentiality and security. It is apparent from the literature review that without these, no EMR will be used. Data ownership, copyright, liability, identification, durability, patient record immutability (factual), processing of personal data and transparency are important medico-legal considerations for the use of an EMR. These are included as proposed CSFs.

After discussion with various GPs, it became apparent that ownership of the data contained within the EMR is an important issue relating to user acceptance. Hence, it is included as a new data variable.

The age, gender and level of education is considered to affect generic EUC, but not doctors' use of computers. All doctors have completed tertiary education hence there will be no difference in their level of general education. Thus, these variables will not be considered in this research project.

A list of final hypotheses were developed from these variables as follows:

Hypothesis 1:

User acceptance will have a positive influence on EUC success, separate to perceived ease-of-use and perceived usefulness.

Hypothesis 2:

Extra-organisational variables will influence user acceptance.

These have been identified by Zinatelli (1994) as having a positive correlation on perceived ease-of-use and perceived usefulness and directly with small firm EUC success therefore this research project will investigate the correlation with user acceptance only.

Hypothesis 2a: External training will have an positive influence on user acceptance.

Hypothesis 2b: External support will have a positive influence on user acceptance.

Hypothesis 3:

Individual intra-organisational variables will have an influence on user acceptance.

Hypothesis 3a: computer experience will have a positive influence on user acceptance.

Hypothesis 3b: user participation will have a positive influence on user acceptance

Hypothesis 3c: personal approach by respected members of the profession will have a positive influence on user acceptance.

Hypothesis 4:

Data variables will have a positive influence on user acceptance.

Hypothesis 4a: Record accuracy, factual and easily retrievable will have a positive influence on user acceptance.

Hypothesis 4b: Privacy, security, and confidentiality will have a positive influence on user acceptance.

Hypothesis 4c: Patient consent will have a positive influence on user acceptance.

Hypothesis 4d: Ownership will have a positive influence on user acceptance.

Hypothesis 5:

Individual/professional/technical variables will have a positive influence on perceived usefulness.

Hypothesis 5a: Individual variables of goals/needs targeted, protect against litigation, decrease workload/pressure, and accountability will have a positive influence on perceived usefulness.

Hypothesis 5b: Professional variables of improved quality of care, and improved seamlessness of care will have a positive influence on perceived usefulness.

Hypothesis 5c: technical variables of improves communication and information sharing will have a positive influence on perceived usefulness.

Hypothesis 6:

Management support has been shown to have a positive correlation with perceived usefulness, and EUC success as shown by Cheney et al (1986) and Zinatelli (1994). Internal training has been shown to have a positive correlation with utilisation and EUC success (Igbaria 1990, cited in Pomare 1992; Cheney et al 1986; Nelson and Cheney 1987; Sein et al 1989; Zinatelli 1994). Internal support has a positive correlation with EUC success as shown by (Rivard and Huff 1988, cited in Pomare 1992; Igbaria 1990, cited in Pomare 1992; Zinatelli 1994). Therefore this research project will investigate the relationship of organisational variables with user acceptance only.

Hypothesis 6a: Realistic expectations/relationships will have a positive influence on user acceptance.

Hypothesis 6b: Internal support and training have a positive influence on user acceptance.

Hypothesis 6c: Management support has a positive influence on user acceptance.

Hypothesis 7:

Technical variables have a positive influence on perceived ease of use.

Hypothesis 7a: System user-friendliness has a positive influence on perceived ease of use.

Hypothesis 7b: Easy to learn has a positive influence on perceived ease of use.

Hypothesis 7c: Access and availability have a positive influence on perceived ease of use and hence with user acceptance.

Hypothesis 8:

Perceived personal cost has a negative influence on user acceptance.

These are the hypotheses, based on a firm theoretical analysis, that will be tested by the research survey. That is not to state that these are the only possible hypotheses, as demonstrating one set of hypotheses does not rule out alternative hypotheses (Miller 1991).

4.4.4. Final Theoretical Model

The hypotheses were then fitted in the initial TAM giving a final theoretical model as shown below shown in figure 2. This is the theoretical model that then formed the basis of the research questions below that were asked in the primary care survey.

4.4.5 Research questions

1. What is the relationship between user acceptance and EMR access systems success?
2. What variables relate to user acceptance of EMR access systems?
3. What is the relationship between perceived ease-of-use and perceived usefulness, and user acceptance of EMR access systems?
4. What variables relate to perceived ease-of-use and perceived usefulness of EMR access systems?

Intra-organisational (H3,4,5, 6, 7, 8)

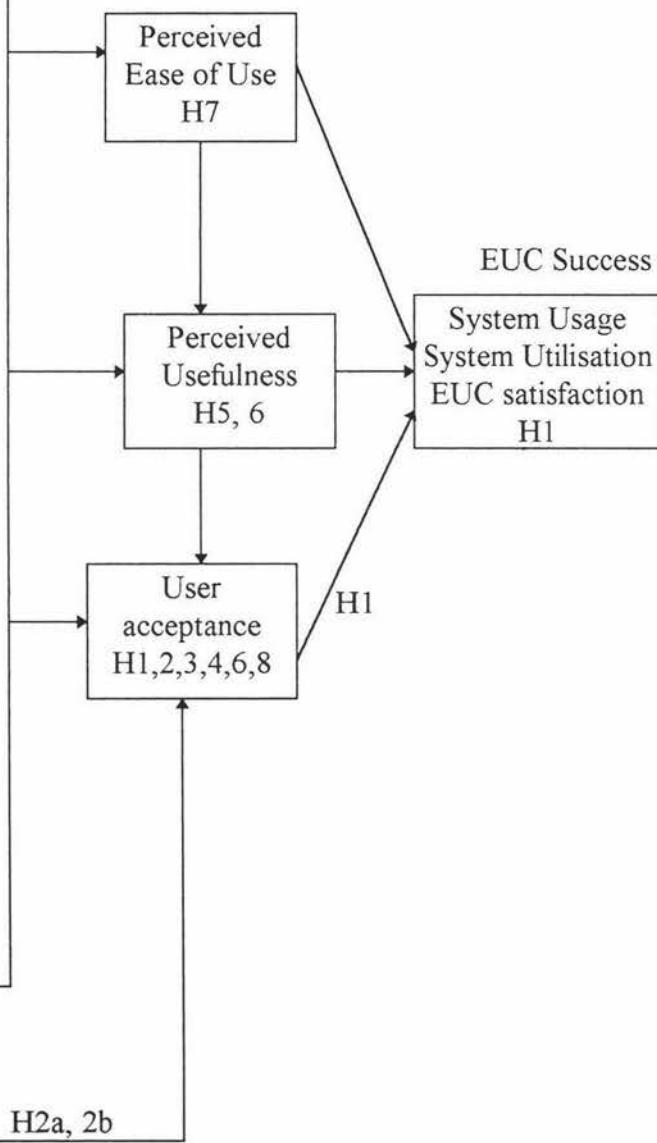
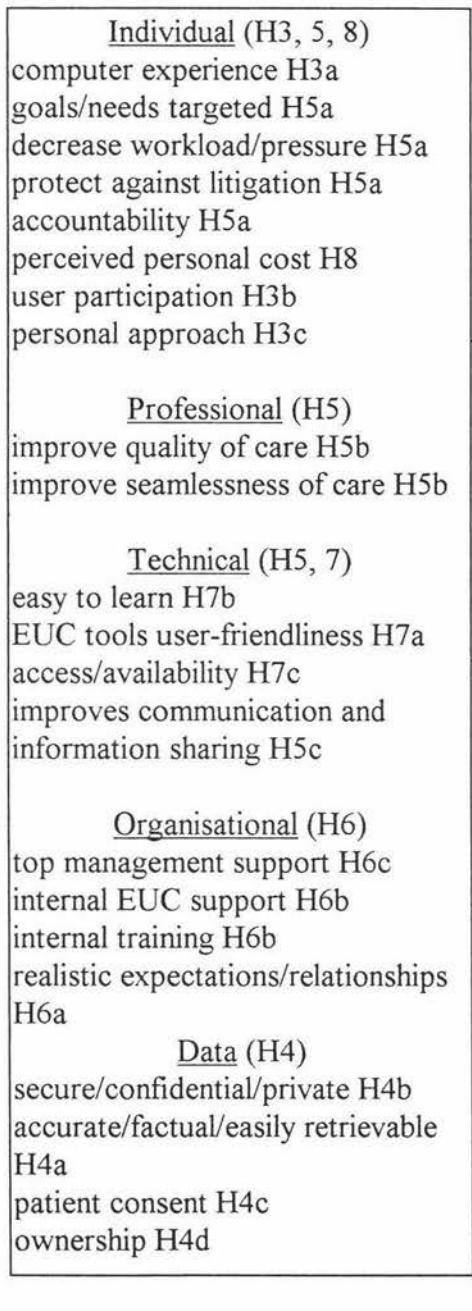


Figure 2: Final theoretical model of critical success factors for electronic medical records access systems showing the final hypotheses.

Summary of Chapter Four

In summary, this chapter identified EMR access systems as a legitimate area of research, located a variety of theories relevant to the objectives of this research project, and selected the Technology Acceptance Model (TAM) to form the basis of an initial theoretical model. A series of initial hypotheses were developed based on the literature review from Chapter Three. The initial theoretical model and hypotheses were subsequently modified to take into account the ethical, economic, and practical limitations of this research project. A final theoretical model and set of hypotheses were presented which formed the basis of a set of research questions which were posed by the primary care survey. The design of the primary care survey is the subject of the next chapter.

Chapter Five - Research design (Instruments and methods)

This chapter discusses the primary care survey design. It considers the formulation of the research design, the operationalisation of the variables, the identification of the sample, the design of the data collection instruments and the collection of the data.

5.1 Research design

Research design provides a master plan or a strategy for selecting the sources and types of information, specifying variable relationships, determining the operationalisation and measurement of the variables, collecting and analysing the data and thus testing the theoretical model. (Lucas 1991b; Zikmund 1994; Cooper and Emory 1995; Polgar and Thomas 1995). The theoretical model may show ‘management support’, but the design phase of the research plan must identify which operational variables will be used to measure management support.

There is no one right research design (Bikson 1991; Miller 1991; Zikmund 1994) but the overall research design is a crucial determinant of the credibility and generalisability of a study as it must address two other measurement problems besides operationalisation - that of reliability and validity (Lucas 1991b; Polgar and Thomas 1995).

Howie (1979) likens research design to developing a recipe for cooking - a stage-by-stage description of the required ingredients and how to use them. He comments that good attention to detail is essential and that complex projects, like cordon bleu cooking, require elaborate planning (p65). He also discusses that no statistical analysis can convert poor quality information into good quality results and thus make up for poor research design (Howie 1979).

Research design is also a compromise between different approaches (Porter 1991; Attewell and Rule 1991; Miller 1991). It is crucial that researchers know that trade-offs are made by selecting one approach over another, that such trade-

offs cannot be avoided, what is given up in the trade-off and therefore which sets of trade-offs they will accept (Attewell and Rule 1991; Porter 1991). These trade-offs are determined by practical considerations such as the research questions, the research resource constraints and if the information required is already in existence or if it is new information (Howie 1979; Bikson 1991; Kling 1991; Miller 1991). Before deciding on the research design for this research project, therefore, the various methods used in IS research were considered.

5.2 Research method: Survey research

The objectives of this research project are to identify the CSFs for EMR access systems. Multiple methods were used, as recommended by (Attewell and Rule 1991; Bikson 1991; Danziger and Kraemer 1991; Eveland 1991; Gutek 1991a, Kling 1991; Porter 1991). Secondary data analysis were used for the literature review and identification of potential variables, field work for the piloting of the survey, and survey research as a ‘methodology of verification’ of the results of the other research methods (Attewell and Rule 1991 pg 313). This allowed the advantages of fieldwork in the pilot study to reduce the disadvantages of survey research. This order follows that used by researchers (Attewell and Rule 1991; Bikson 1991; Danziger and Kraemer 1991). Kling (1991) considers that it is extremely helpful to repeat the field work afterwards as a means of better understanding what respondents told through the survey instruments. However, lack of resources precluded this from happening in this research project.

Despite the advantages of experimentation research of high internal validity through random assignment to conditions, total control over the conditions wanted and manipulation of the variables as desired, thus enabling causal relationships to be identified and explored (Gutek 1991a; Miller 1991), this method was not selected for this research project. It was not considered possible to randomly assign GPs to different experimental situations and control for behavioural attitudes and intentions.

Survey research was selected as the method to apply the theoretical model because it has been the standard scientific method for studying individual level behaviour, and provides information at both the individual and aggregate levels of analysis (Kraemer and Dutton 1991). It provides more cases and more systematic data than case studies, thus facilitating more rigorous hypothesis testing and generalisation (Danziger and Kraemer 1991; Kraemer 1991). It is the most prevalent research tool applied to MIS research, being used in approximately one-third of current MIS research in MIS (Vogel and Wetherbe 1984, cited in Mason 1991; Kraemer and Dutton 1991; Zmud and Boynton 1991).

The field study pilot survey enabled testing of the questionnaire to disclose any amendments that needed to be made in the variables used, variable operationalisation, questionnaire design or question construction before the formal survey phase. The use of secondary data in the literature review to identify those variables that previous researchers had identified as potential critical success factors for electronic medical records access systems may have resulted in some limitations of the project results, especially in the omission of some potentially important variables (Culnan 1991; Eveland 1991; Gurbaxani and Mendelson 1991). Whilst the literature review produced information that is proposed will relate to CSFs for EMR access systems by GPs, there is no information in any published information that identifies definitely these CSFs, thus survey research is appropriate to use to identify this information (Statistics New Zealand 1995).

5.3 Data collection technique

Having selected the underlying methods to be used in the research design, the next step is to select the data collection technique. There are a variety of data collection techniques and, similar to the research method selection, the appropriate data collection technique(s) for each situation is one which is valid and reliable and depends on the aims, design and resources of the research project (Howie 1979; Polgar and Thomas 1995).

Within survey research, there are a variety of techniques of obtaining information from people. These include a survey, interviews, observations, performance tests, and record reviews (Berdie and Anderson 1974; Alwin 1977; Fink and Kosecoff 1985; Kraemer 1991; Polgar and Thomas 1995). A survey was selected as the data collection technique. The other techniques were not considered appropriate for this research project as the EMR access system does not exist yet hence observation or performance testing of it's use was not possible, and there are no records to review.

Surveys are considered the best way to obtain information such as attitudes, opinions and beliefs, and demographic characteristics, directly from the people involved. (Fink and Kosecoff 1985; Polgar and Thomas 1995). They involve well-defined concepts, methods and procedures, and the compilation of useful summary information (Statistics New Zealand 1995). The ability to sample and collect data on a large number of units makes surveys a cost effective method of achieving generalisable results (Vitalari and Venkatesh 1991). Surveys use a questionnaire to gather data from a sample of the population and are not only a powerful data collection tool, but the most common method of gathering primary data in the social sciences (Vitalari and Venkatesh 1991; Zikmund 1994). Finally, survey research can enable both quantitative and qualitative data to be analysed with parametric and nonparametric statistics (Miller 1991; Polgar and Thomas 1995). Thus, survey research fits the aims, design and resources of this research project.

5.4 Survey management

Similar to the compromises required in selecting a data collection technique, there are various compromises or trade-offs that need to be considered with the use of a survey method. Basically, these involve the balancing of time and resources with the needs of the survey sponsors and users (Statistics New Zealand 1995). Some of the issues that need to be considered are as follows:

- planning - project management with contingencies, a realistic time horizon, money

- consultation - with the users of the survey results and sponsors regarding changes to be made
 - design - determine the type of data collection technique, to use CATI (computer-assisted telephone interviewing) or not, use of existing definitions or development of new ones, reliability and validity, sample or census, questionnaire design
 - pre-tests and pilot surveys - to test the survey method and to assess the likely response rate
 - operation - establish the mechanics of dispatch, return, storage, recording, security and destruction of questionnaires, the collection of the data, access to the potential respondents in line with sponsor requirements and ethical practice
 - non-response - techniques to ensure as high a response rate as possible, and how to deal with non-responders
- (Statistics New Zealand 1995)

How these issues were addressed is discussed in this chapter.

5.4.1 Planning and consultation

A project timescale was developed at the onset of the research project with built-in leeway for contingencies. This timescale was discussed with and agreed to by all parties involved in the project. Any problems that developed with the project time scale were quickly identified and discussed with all involved parties and any amendments agreed to.

5.4.2 Data collection technique

Data collection by survey can be divided into two groups - self-completed surveys and interview-administered surveys. Interviewer-administered surveys include both face-to-face interviews and telephone interviews which may include CATI. Self-completion surveys include mail questionnaires, other self-completed questions, i.e. done at a particular place such as a visitor centre and computer response questionnaires (Statistics New Zealand 1995).

Thus, in deciding on the collection technique to be used in this research project , the following factors which may influence the choice of survey data collection technique were considered: nature of the questions, response rates, resources, time, the population of interest including geographical distribution, sample size, and the nature of the population itself, the accuracy of information desired and the reliability and validity of the survey results (Berdie and Anderson 1974; Dilman 1978; Miller 1991; Statistics New Zealand 1995; Folz 1996).

The three most common techniques of collecting survey data are self-administered questionnaires, face-to face and telephone interviews Each has advantages and disadvantages (Berdie and Anderson 1974; Alwin 1977; Dilman 1978; Howie 1979; Attewell and Rule 1991; Gutek 1991a; Vitalari and Venkatesh 1991; Folz 1996). However, there is no consensus about the best technique for any particular situation as the relative importance of each factor affecting the choice will vary from research project to project.

Fink and Kosecoff (1985) discuss that for the survey results to be useful and credible that the survey device has to be one that the respondents accept as the correct one. The topic of this research project is one that may be new to many in the sample population and may lead the respondents to feel that major changes in their work style may be needed. This can result in low response rates (McAvoy and Kaner 1996; Springer and van Marwijk 1996). It was felt that providing the opportunity to ask questions, clarify points and determine the future impact of developing an EMR system in secondary care that primary health care professionals could access, would increase both the value of the information obtained from the respondents and the response rate (Alwin 1977; Dilman 1978; Statistics New Zealand 1995; Lydeard 1996; McAvoy and Kaner 1996; Springer and van Marwijk 1996). Thus, interviews were initially looked at as the means of data collection.

Interviews, compared with other techniques of data collection, usually have a high rate of return; the information obtained more likely to be correct; they provide information on respondent's spontaneous reactions; supplementary information

gathering is possible; can present visual material; have higher response rates with longer questionnaires; the researcher can control who answers the questionnaire and can arrange return visits to clarify points and strengthen the relationships between the researcher and the participants; and interviews are especially useful in cases that involve privacy issues and sensitive questions (Berdie and Anderson 1974; Dilman 1978; Fink and Kosecoff 1985; Gutek 1991b; Miller 1991; Vitalari and Venkatesh 1991; Polgar and Thomas 1995; Statistics New Zealand 1995; Folz 1996). It was felt that these advantages outweighed the disadvantages of increasing costs and lower response times in large cities; needing more time than other methods; respondent access being dependent on time of day; that respondents may alter answers to 'please' the interviewer; and that interviewer bias may affect the results (Berdie and Anderson 1974; Dilman 1978; Miller 1991; Vitalari and Venkatesh 1991; Polgar and Thomas 1995; Folz 1996).

The use of semi-structured questionnaires is a compromise between the time saving and conformity of information collection advantages of structured interviews versus the ability to explore the respondent's current interests and concerns, and for the respondents to answer in their own words and have some input into the research project (Attewell and Rule 1991; Bikson 1991; Polgar and Thomas 1995). Semi-structured interviews include a set list of closed questions but also include open questions to elicit respondents' interests and concerns and enable the respondents to have an input into the research project. It was felt that this technique would provide the advantages of both types of interview techniques whilst minimising their respective disadvantages. Interviewer bias would be minimised by using one interviewer -the researcher. Another factor in favour of semi-structured interviews is that both telephone and mail surveys were developed for surveys of the general population (i.e.: individuals in their own homes) and have substantial drawbacks in business settings. Many businesses, including GPs, have been inundated with both mail and telephone surveys which has resulted in a considerable resistance to answering mail and telephone surveys, leading to a low response rates unless special measures are applied (Attewell and Rule 1991; McAvoy and Kaner 1996).

A telephone survey was considered as it has higher response rates than mail surveys, is more convenient for the researcher, is less expensive than in-person surveys, is often more pleasing for the respondent, and enables the researcher to develop a relationship with the respondent and to achieve an interactive exchange much more complex and adaptive than other forms of survey data collection allow (Berdie and Anderson 1974; Dilman 1978; Vitalari and Venkatesh 1991; Folz 1996). It was felt however, that these benefits did not outweigh the advantages of semi-structured interviews in this situation.

Similarly, whilst information technology has extended the utility of surveys and increased the efficiency of survey data collection efforts, it was felt that the increased resources and interviewer training required for CATI (computer-assisted telephone interviewing) outweighed the advantages of improved access to respondents, increased accuracy, completeness, speed, and processing power that this data collection method offered (Anderson 1991; Gutek 1991a; Shanks 1991; Vitalari and Venkatesh 1991). CATI is only cost effective for large sample sizes (Vitalari and Venkatesh 1991). CATI also requires a change in the organisation (Anderson 1991). However, the major problem with CATI is that there needs to be further exploration of new ethical issues as it may be easier to inadvertently violate confidentiality of respondent data, guaranteeing informed consent may be more difficult, it may be very easy to mislead respondents with item formats and ambiguous question displays, plus poor design with lack of help functions and poor user interfaces should be viewed as an unethical exchange for the time asked from the respondents (Anderson 1991). Whilst CATI-type systems are being developed in areas other than telephone interviewing, for example: computer-assisted personal interviewing (CAPI); self-administrated questionnaires (SAQ) for respondent-entered data; and direct data entry (DDE), for paper-and-pencil forms (Anderson 1991; Shanks 1991), both CAPI and SAQ require respondents be brought into direct contact with a computer (Shanks 1991) and has the potential problem of the ethical issue of lack of informed consent to supply personal information (Anderson 1991). Both access to, and use of, a computer and informed consent have been identified as potential CSFs for this research project hence it is likely that respondents would have problems with using CAPI and SAQ. Anderson

(1991) also comments that further evaluation is needed to determine if there is unique biases with CAQ methods of surveying such as higher non-responses due to the skills and perceptions of the respondents, or a higher number of socially undesirable responses due to a uninhibiting effect of computerised response environments. Therefore, CATI was not employed by this research project.

Information technology was however, used in the statistical analysis, text processing and document preparation, and data management tools of this research project (Shanks 1991).

In summary, considering all the above, it was initially decided to use semi-structured face-to-face interviews with the target population sample. This was selected as the data collection technique because the topic is new, the potential number of respondents is less than 200, all are located in the same geographical area, and the response rates to postal questionnaires is declining. After the pilot survey, the data collection technique was altered to a postal questionnaire as face-to-face access to the target population proved to difficult and very time consuming, and the pilot study respondents expressed a preference for postal questionnaires over face-to-face interviewing.

Having decided on the research method and data collection technique, the next step in the research process is the operationalisation of the proposed variables, and addressing the issues of reliability and validity (Lucas 1991b; Polgar and Thomas 1995).

5.4.3 Operationalisation

Operationalisation refers to the process of converting theoretical ideas to an unambiguous statement of how variables in a particular study are to be measured. It allows the adequacy and appropriateness of the measures to be assessed and good measurement techniques increase the validity of the research. The statements should contain enough information to enable another investigator to replicate the measurement techniques if so desired (Polgar and Thomas 1995).

Operationalisation is important as demonstrated by Daft's *ad hoc* analysis of the reasons he rejected 111 manuscripts submitted to the *Administrative Science Quarterly* and the *Academy of Management Journal* (Daft, cited in Zmud and Boynton, 1991). He gives as a reason for rejecting 32% of manuscripts, that constructs and operationalisation were not in alignment (14 percent of reasons; 32 percent of manuscripts).

Zmud and Boynton (1991) discuss that constructs are the basic elements used in the development of scientific theories, thus they play a central role in the evolution of a field of inquiry. 'Well-developed, universally recognised constructs provide the standardised language through which researchers in a field communicate with and learn from one another in their quest to understand complex phenomena.

Constructs, however, are conceptual, not empirically observable, entities. As noted in McGrath, Martin, and Kulka (1982, cited in Zmud and Boynton 1991), a researcher testing a relationship between two constructs, X and Y, must develop operational definitions -x for X and y for Y. As a consequence, four relationships, rather than one, are involved:

- that between X and Y (a theoretical relationship, which cannot be empirically tested);
- that between X and x (a definitional relationship, which can be only indirectly tested);
- that between Y and y (a definitional relationship, which can be only indirectly tested); and
- that between x and y (an empirical relation, which can be tested).

Whilst the operationalised variables, x and y, must be clearly defined to prevent confusion, the precise definition is at the discretion of the individual researcher (Howie 1979). The use of common definitions, e.g. from a glossary, reduces the risk of misinterpreting reported results (Howie 1979). Similarly, there is no one single best way of taking measurements of x and y, particularly in the case of social and clinical variables (Polgar and Thomas 1995). This can give rise to some difficulties with operationalisation, especially in the field of MIS research. Fink and

Kosecoff (1985 p40) discuss that "it is very difficult to define and measure general attitudes, feelings, and ideas because there are many conflicting theories of personality and development". The operational indicators for different concepts frequently appear to be similar, and frequently are highly interrelated - makes it difficult to assess findings across studies, i.e.: similar surrogate indicators are used to measure separate unique theoretical constructs (Kraemer and Dutton 1991). Thus, there can be problems in defining X and Y, and in defining the relationship between X and x, and Y and y, and lastly, there can be problems with the measurement of x and y. Similarly, assertions regarding X and Y are a function of the reliability and validity of the measures of x and y (J.E. McGrath, J. Martin, and R.A. Kulka 1982, cited by Zmud and Boynton 1991). It is therefore necessary to look at how one measures x and y.

Measurement is the procedure of attributing qualities or quantities to specific characteristics of objects, persons or events and the tools used for such measurement should yield measurements that are reproducible, accurate, applicable, and practical or easy to use, i.e.: reliability, validity, applicability, and practicability. (Polgar and Thomas 1995). Poor measurement procedures limit the internal and external validity (Zmud and Boynton 1991) and the use of general measures, whilst increasing external validity, may decrease internal validity and single system (non-general) measures are more tailored to the particular system and its environment so that internal validity is likely to be higher (Ives and Olson 1984).

Likert scales were selected as one means of measuring the relationship between the variables proposed as CSFs in this research project as they permit measurement of intensity of feeling with regard to a particular attitude or attitude complex, produce an ordinal scale that usually requires nonparametric statistics and can be used cautiously for composite scores to compute means or correlations in the data analysis stage, and are used by the majority of published MIS research instruments (Miller 1991; Newsted, Munro and Huff 1991; Zmud and Boynton 1991; Folz 1996).

Rating/ranking scales were the other means used of measuring the relationship between the variables proposed as CSFs in this research project as they are a type of ordinal scale that seek a quantitative judgement assessing attitudes, values, norms; show the latent dimensions of self-direction and conformity and may force a contrast between them by asking respondents to make choices that they would not otherwise make (Fink and Kosecoff 1985; Converse and Presser 1986; Miller 1991).

A final problem in operationalisation is that no survey instrument can measure the total range of variables that characterise organisational life. Surveys are necessarily simplified due to resource constraints, either by measuring a relatively small selected set of behaviours very carefully or by measuring a wider set more crudely (Kling 1991).

A decision was made in this research project to limit the major variables that will be measured by this research project to user acceptance, perceived ease-of-use, and perceived usefulness. Both perceived ease of use and perceived usefulness have existing measurement scales of known reliability and validity, with multiple items for each operational variable, and a consensus agreement on definitions (Davis 1989; Davis et al 1989; Lucas 1991b; Mathieson 1991; Moore and Benbasat 1991; Adams et al 1992). The measurement scale for user acceptance was developed from the measurement scales for perceived ease-of-use, and perceived usefulness in order to increase reliability and validity. The variables proposed to influence these major variables were identified from the literature review, as shown in Table 1, Chapter Three and then restricted to those proposed in the final hypotheses in Chapter Four. All these variables and hypotheses are essentially theoretical constructs, and as such, need to be operationalised prior to the development of the survey questionnaire. This process of operationalisation is discussed in the next section.

Variable operationalisation

There are many variables that the research project proposes to have an influence on perceived usefulness, perceived ease-of-use and user acceptance that will not be measured (cf.: appendix 2). The relationship between all these variables is that if a respondent believes they are important then they relate, what actually constitutes or defines that variable is not measured. For example, quality of care is proposed as a variable that will influence perceived usefulness. This research project will not address what constitutes quality of care, that is an area for another project, it is whether that the respondent feels that an improvement in quality of care is an important or not important feature of an information system that is under consideration.

The operationalisation of the variables and their subsequent definitions used in this research project are detailed in Appendix 2.

Reliability and Validity

The aim of good research design is to select research designs that are strong in both internal and external validity and reliability (Berdie and Anderson 1974; Howie 1979; Miller 1991). However, the elements that increase one type of validity frequently reduce the other (Miller 1991) and what is considered an acceptable level of reliability will vary between projects (Howie 1979).

A reliable method is one which produces repeatable results over time (Berdie and Anderson 1974; Howie 1979; Lucas 1991b). It is determined by repeating the experiment and measuring the ability of the methods to produce consistent results (Howie 1979; Lucas 1991b). Reliability is improved by better definition of procedures and criteria, and is greater in prospective than in retrospective studies (Howie 1979). The use of existing measurement procedures and instruments that have known levels of reliability and validity increases the validity and reliability of research results (Polgar and Thomas 1995).

Reliability of the primary health care survey instrument results was increased by using existing variables and questions where they existed and were appropriate, i.e.: for perceived ease-of-use and perceived usefulness (Davis et al 1989; Adams et al 1992) but financial and time constraints prohibited the replication of this survey.

A valid method is one which measures what is sets out to measure with acceptable accuracy but what is considered an acceptable level of acceptance may vary between different projects and will have to be decided for each project (Howie 1979; Lucas 1991b; Stone 1993). It is assessed by comparing results produced by the method to those produced using other standard methods (Howie 1979). Validity is affected by unreliability and by observer or subject bias (Howie 1979). Thus, questions about validity can be reduced by using a standard survey form that has been validated by someone else (Polgar and Thomas 1995). This only works well when the standard survey asks questions relevant to the study (Lucas 1991b) and general surveys are only useful for IS in general and may not be helpful for specific systems. Thus, the requirement that one uses only validated instruments may preclude research dealing with individual information systems (Lucas 1991b). Another problem is that validation of an instrument for a single system using existing validation techniques is not possible unless the system has an extremely high number of users. When using new methods of study, the assessment of the quality (reliability + validity) has to be individual to the project concerned - there are no ways of checking validity and reliability other than by repeating observations with the same and different subjects and observers, and comparing the results found because no standards exist for comparison (Howie 1979; Stone 1993).

As this survey addresses a specific area of IS, general IS surveys have limited use, and as it is a research area that has not previously been investigated in detail, there were few existing validated specific variable definitions or questionnaires to use. Additional problems with demonstrating validity and reliability for the survey instrument used in this research project was the type of research itself. It becomes more difficult to assess reliability and validity objectively as one moves from laboratory research to behavioural research (Howie 1975). In summary, the validity

of the primary health care survey questionnaire was increased by using previously validated variables and questions where they existed and were appropriate to use (Davis et al 1989; Mathieson 1991; Adams et al 1992) and the rest of the questionnaire was validated by pilot testing as discussed later in this chapter.

Having discussed the data collection method, operationalisation and reliability and validity, the next major stage of the research process is the selection of the sample. (Lucas 1991b; Zikmund 1994; Polgar and Thomas 1995; Statistics New Zealand 1995).

5.4.4 Sample identification

This section discusses the sampling methodology used in the research project. It is divided into three areas - the target population, the sampling unit, and the sampling size.

Identification of a target population

The target population is the entire group from which it is desired to obtain information and needs to be as exact a definition as possible (Statistics New Zealand 1995). The research project title is CSFs for EMR access systems. There is no mention of the target population.

An EMR can operate in the interests of a number of people and has potentially a wide audience in New Zealand including but not restricted to clinicians, nurses and professions allied to medicine, administrators, hospital management, ACC, DSW, voluntary agencies, and even education services (Pritchard et al 1984; Dowling 1992a; GEHR 1993; Kelly 1993; McCormick and Boyd 1994; CRHA 1996). Hence, the target population can be defined as all those people with a legitimate reason to access data contained within an EMR. The actual number of this target population is unknown.

A survey population is the group that have a chance of being selected as part of the sample (Statistics New Zealand 1995). The larger the sample size, the more precise the data collected and the lower the sampling bias, but it is unrealistic, unnecessary, extremely costly, unethical and sometimes impossible to select every potential respondent (Howie 1979; Boyle and Langley 1989; Zikmund 1994; Polgar and Thomas 1995; Hamilton 1996). The choice of sampling unit also influences the sample i.e.: individual, group, organisation (Lucas 1991b).

Whilst random sampling allows the researcher to generalise from the sample to the population from which it is drawn, this is only possible when a population can be identified (Attewell and Rule 1991; Gutek 1991b; Kling 1991; Lucas 1991b). As the target population for EMR access systems is unknown, random sampling was not possible. Another reason why random sampling was not possible was that, generally, survey research is conducted in situations in which subjects agree to participate - hardly a random group (Lucas 1991b).

However, even though random sampling is recommended, there are situations in which researchers use other than random sampling, for example, where there is no listing of the population available from which the sample can be drawn, as in this case, the researcher faces a dilemma. They can either draw a truly random sample from a list that poorly matches the theoretical universe one is interested in, or they can develop a sample that fits better one's theoretical purposes, but which isn't random or representative (Attewell and Rule 1991). However, the use of non-random sampling creates problems and the results may not be accepted by many quantitative researchers, the exception being where a purposive sample of firms is selected (Attewell and Rule 1991).

Purposive sampling involves selecting organisations or individuals because they exhibit features of central concern to the researcher (in this study, obstetric primary health care professionals), and reflects the way researchers conceptualise the object of the study, the organisation and the particular research questions to be answered (Attewell and Rule 1991; Bikson 1991). The choice of individual informants or workgroups within the purposively sampled firms is carried out by random

sampling (Attewell and Rule 1991). Purposive sampling is a form of theoretical sampling (or convenience sampling), the sampling is along theoretically interesting dimensions, testing the strength of the relationships among a set of variables of interests, and permits the examination of smaller social units (Gutek 1991a; Kling 1991). Theoretical sampling requires some kind of theoretical argument about which characteristics of organisations are likely to explain major differences in outcomes.

This research project has a theoretical basis hence theoretical sampling is an acceptable alternative to random sampling, provided it is remembered that there can problems identifying the characteristics of organisations or their subunits and choosing the wrong theoretical dimensions puts one in a weaker position to generalise than simply choosing a random sample (Kling 1991).

Using the limitations placed on this research project, as discussed in Chapter 2, the target population was redefined as those general practitioners (GPs) eligible to be lead maternity carers (LMCs) under Section 51 (1996) in the secondary health care institution catchment area. This population definition was further modified after the pilot study to include all primary health care professionals (GPs, midwives, obstetricians) eligible to be lead maternity carers (LMCs) under Section 51 (1996) in the secondary health care institution catchment area. Thus, purposive sampling was used to select the target population of the research project and the limits in generalisability are those of purposive sampling. It is acknowledged that there may be characteristics of this group that limit the generalisability of the results of this research project to GPs in general in New Zealand, and that CSFs for EMR access systems as determined by GPs may differ from those for other groups interested in accessing EMR systems. Some demographics of the respondents to the survey were collected to determine how representative a sample the target population was, of New Zealand GPs in general.

The sampling unit

Determining the unit of analysis is a crucial part of research design (Zikmund 1994) and the level of the sampling unit (the level of analysis) may range from individual people to work groups to firms to industries to nation states. It should fit the research questions, thus be dictated by the theoretical purposes of the research and should follow common sense about who in a firm can reasonably be expected to know about various facts (Attewell and Rule 1991; Danziger and Kraemer 1991; Gutek 1991a; Kling 1991). The research questions for this research project involve individual health professionals, therefore the unit of analysis for this research project is the individual health professional.

Sampling size

Having defined the target population and the sampling unit, the next question was to determine sample size. This is determined by such factors as the available resources of time, money, personnel, and equipment (computers /software /envelopes); and the required accuracy of the results.

Larger sample sizes are recommended to ensure a representative sample, to enable multivariate analyses and determine causal relationships and to provide greater statistical power (Attewell and Rule 1991; Danziger and Kraemer 1991; Lucas 1991b). However, with large enough sample sizes, even tiny relationships can become statistically significant, and studies with medium to large samples are very expensive (Kling 1991). Smaller sample sizes enable a thorough job of observing and measuring variables and allows the researcher to spend plenty of time at each research site (Attewell and Rule 1991).

The total number of all primary health care professionals eligible to be LMCs in the secondary health care institution region was estimated to be less than 200, therefore a decision was made to contact them all. This gave a sample population size of 100% the target population, thus removing any arguments about the representative nature of the sample and the desired sample size.

A sampling frame is a list of units covering the target population such as a physical list of names, or a geographical area, where each unit counts, and counted only once, each unit is distinguishable from other units, and up-to-date information is available (Statistics New Zealand 1995).

One major problem that was encountered in the research project was to determine the sample frame. There was an overlap between the list of LMCs that the secondary health care institution had, with the list from the primary health care organisation that participated in the research project. There were, however, members of the primary health care organisation who did not practice as LMCs and there were some primary health care professionals, who were not members of the primary health care organisation, who felt that they had LMC entitlement but were also not on the secondary health care institution list. The secondary health care institution did admit that their list was not up-to-date. A decision was made to define the sample frame and thus the target population as those primary health care professionals who were on the secondary health care institution list, and/or members of the primary health care organisation, or considered themselves eligible to have LMC status. The registration of LMC status with the Regional Health Authorities in New Zealand and with the secondary health care institution is an on-going process and there may be some primary health care professionals who registered after the commencement of the survey phase, but it is felt that this number would be extremely small. The target population was thus derived from three sampling frames - the secondary health care institution list, the primary health care organisation list, and the telephone book of listed obstetric / midwifery providers.

Despite requests from the researcher to both the primary health care organisation and the secondary health care institution not to be given the physical lists of members, in order to avoid the researcher being accused of any possible breaches of the Privacy Act 1993, both organisations insisted on handing over the physical lists, even though each organisation wrote the covering letters and posted out the questionnaire to their respective members. The researcher kept both lists secure

and separate from the data analysis in order to preserve respondent anonymity and confidentiality.

Having decided on semi-structured interviews as the data collection method, defined the variables and considered their operationalisation, and selected the sample population, the next step was to design the data collection instrument - the questionnaire itself - that would be used in the primary care survey.

5.4.5 Design of data collection instrument - Questionnaire design

- Each questionnaire must be “hand-crafted”, as questionnaire writing is an art, and each questionnaire is unique (Alwin 1977; Converse and Presser 1986 p48; Folz 1996). The stages that questionnaire must go through in being hand-crafted are 1)exploration, and 2)pretesting (Converse and Presser 1986).

Exploration involves having a clear set of research proposals, a knowledge of any existing work on the topic, and an idea on how the survey could add extra information. Converse and Presser (1986) recommend consultation with people of different viewpoints to turn up new information and in-depth interviews with members of the target population. The people consulted in the construction of this questionnaire included IS professionals, University academics in the area of IS, friends and family who had no connection with IS, staff of the target population organisations, and members of the target population itself. Existing work was identified through literature searches and personal contact with other researchers. Existing work included identification of existing questionnaires designed by other researchers on the topic of end-user computing, and their implementation into both large and small organisations.

This stage also involves ensuring that the questions cover the “complete domain of content that is considered important to the survey” (Fink and Kosecoff 1985 p25). This domain for the research project was obtained by an extensive literature search and personal contact with other researchers in the field.

As discussed in the section on operationalisation, the use of existing variable definitions based on existing theory increases the validity of the survey results. Similarly, it is important to distinguish, as a criterion of evaluation, between instruments and scales that are based on existing theory and instruments that are not (Converse and Presser 1986; Benbasat 1991; Miller 1991). However, whilst it is recommended that existing well-developed, or fairly well-developed, instruments that fits the level of analysis and level of detail are used rather than developing new instruments (Converse and Presser 1986; Benbasat 1991; Miller 1991; Zmud and Boynton 1991; Folz 1996), there are problems with using existing instruments and scales.

One cannot be sure that the original questions were accurate, valid or reliable ones in the first place; and the original questions may not fit the new technologies or the language may be out-of-date (Converse and Presser 1986; Zmud and Boynton 1991). The wording and design of existing questionnaires are not commonly reported in the published results of surveys in the MIS journals (Kraemer and Dutton 1991) and there are few well-developed survey instruments used in MIS research that demonstrate adequate reliability and validity (Converse and Presser 1986; Benbasat 1991; Newsted, Munro and Huff 1991; Zmud and Boynton 1991). There may not be an existing questionnaire that fits the level of analysis and detail (Zmud and Boynton 1991) or the theoretical meanings and the operational definitions of the variables in the questionnaire may not be appropriate to a particular research context (Converse and Presser 1986; Benbasat 1991; Swanson 1991).

Content of the questionnaire

Poor questions and questionnaires lead to an increase in non-sampling error, an increase in the partial and overall non-response rate, reduces data quality, and are harder to answer than well designed questions and questionnaires (Zmud and Boynton 1991; Stone 1993; Statistics New Zealand 1995). As existing instruments may serve as useful starting points in operationalising the variables central to the research model being examined (Zmud and Boynton 1991), this research project

used existing instruments and scales where they existed and demonstrated adequate reliability and validity and new questions were developed where necessary (c.f.: appendix 2). These new questions used existing scales that followed Zmud and Boynton (1991) criteria of quality assessment (Swanson 1991; Zmud and Boynton 1991). To that end, the new questions used either Likert scales or ranking/rating scales.

However, the quality of the developed survey instrument depends not only on the quality of operationalisation but also on the characteristics of the survey instruments and the delivery of the survey instrument, as a construct could be well operationalised but the survey fail because of low quality in other areas (Benbasat 1991). To increase the quality of the survey instrument, the questionnaire was designed using the Total Design Method, espoused by Dilman (1978), taking into consideration the objectives, cost, sample size and design, type of analysis, report writing, data input method and data processing method, survey population and other users and the method of delivery (Miller 1991; Statistics New Zealand 1995) and following the steps recommended for developing a new questionnaire by Stone (1993).

These steps are:

1. decide what data you need
 2. select items for inclusion
 3. design individual questions
 4. compose wording
 5. design layout
 6. think about coding
 7. prepare first draft and pretest
 8. pilot and evaluate
 9. perform survey
 - 10.start again

Step 10 however, was left for another research project.

The objectives of the survey questionnaire were to test the hypotheses based on the theoretical model. The resources available to the research project precluded the use

of CATI/CAQI. The sample size and design, and survey population have been discussed previously. The type of analysis was quantitative, mainly descriptive with some multivariate analysis. The report writing was based on the quantitative findings. The data input method was manual data entry by the researcher to permit computerised statistical analysis. A literature review on the response rates by GPs to questionnaires supported the decision that face-to-face semi-structured interviewing would be method of delivery (McAvoy and Kaner 1996). Whilst this was later changed to a postal questionnaire based on the results of the pilot study, the questionnaire was initially designed for semi-structured face-to-face interviewing and then modified for postal distribution.

Having decided on the content of the questionnaire, there were some decisions to be made about the structure of the questionnaire.

Structure of the questionnaire

The questionnaire was designed to contain an introductory statement, followed by demographic questions to ‘warm up’ the respondents. Factual questions followed then to continue the warm up and to get respondents confident about answering the questionnaire. The more difficult open questions were placed at the end. This follows the recommendations by Polgar and Thomas (1995). However, this order is debatable, as some researchers feel that the demographics should be after the opinion questions when the respondents may be getting tired (Folz 1996). However, using open questions after closed questions helps explore the meaning of items (frames of references) and is an “efficient way of combining some of the advantages of both open and closed questions” (Converse and Presser 1986 p43).

A ‘don’t know’ option was added to some of the available answers to the survey questions because respondents in the pilot study requested the option - particularly in the question relating to the Indicative GP register. Some GPs did not know if they were on this register or not, making them have to choose yes or no only created difficulties for them, as it was not a simple matter for them to find out, hence they were forced either to answer falsely or leave the answer blank.

Experimental research shows that offering such an option will affect from one eighth to one third of the respondents (Converse and Presser 1986).

The addition of a middle alternative was considered as Converse and Presser (1986) discuss that split sample experiments show that it is not unusual for upto 20% of respondents to choose a middle alternative when it is offered although they would not volunteer it if it were not mentioned. There is, however, a risk of suggesting a non-committal answer to the respondent (Moser and Kalton 1972 cited in Converse and Presser 1986 p36; Polgar and Thomas 1995).

A solution is to measure intensity of feelings as these have been shown to predict both attitude stability and attitude constraint, and hence identify respondents who will be more consistent over time as well as more consistent between topics (Converse and Presser 1986). Thus, rather than ask if the independent variable relates to the dependent variable or not with a don't know or uncertain middle alternative, this survey uses 5-point intensity indicators such as strongly agree to strongly disagree and very likely to very unlikely. It is acknowledged that such an approach runs the risk of suffering from the risk of extreme response mode where the respondent never selects an intermediate point on either rating scale (Polgar and Thomas 1995).

The use of scales with multiple items addressing the same question or using the same question phrased in different ways is a means of reducing respondents answering in a certain way based on the wording of the question, overcomes flaws in single question construction and reduces extraneous influences, thus increasing the validity and reliability of the results (Converse and Presser 1986). Multiple indicators also make it possible to uncover complexity in the research topic, make it easier to discover if the topic understanding is inadequate and thus are the strategy of choice (Converse and Presser 1986). However, multiple forms of the same question are not equivalent, and reduces sample size whilst increasing the number of questions in the questionnaire (Converse and Presser 1986). As the questionnaire was already quite long, the use of multiple items addressing the same

question was limited so as not to lengthen the questionnaire any further and thus reduce response rates (Dilman 1978).

After deciding on the structure, content and design of the questionnaire, the next step was to pilot or pre-test the questionnaire.

Pretesting/pilot surveys:

The second stage of question writing according to Converse and Presser (1986) is that of pre-testing or pilot surveying.

A pilot survey is a “dress rehearsal” or a ‘practice run’ for the main survey (Miller 1991; Statistics New Zealand 1995 pg 65). Pilot surveys are part of quality assurance, enable error correction and minimisation at an time when it takes less time and money to fix than during the main survey, provide information on the feasibility of the sample selection plan, the variability of the target population, fieldwork procedures, response rate, processing procedures, estimates of cost, are crucial to doing surveys that yield good, analysable data sets and therefore should always be conducted (Converse and Presser 1986; Gutek 1991a; Miller 1991; Statistics New Zealand 1995). Pretesting enables checking of the data collection instrument for appropriateness, and for errors in design such as incorrect wording, structure thus it improves reliability and validity (Fink and Kosecoff 1985).

Pretesting also permits sample data analysis to check that the survey will answer the research hypotheses. The time spent in planning and pre-testing the questionnaire is directly related to the quality of the results (Zikmund 1994; Converse and Presser 1996; Folz 1996).

The pre-test used in this research project was a participating pre-test as the respondents were told that it was a “practice run” (Converse and Presser 1986 p52). This option was chosen as it afforded the possibility of asking detailed questions about the format and layout of the questionnaire, the number, order, wording, meaning and flow of the questions, and the mode of delivery of the questionnaire. It permitted an assessment of the respondents’ interest and

attention, an area that Converse and Presser (1986) feels gets little attention but is important as survey data deteriorates when the respondent's interest and energy flags. It also enabled different wordings of the same question to be tried out. All these are purposes of pretesting (Converse and Presser 1986).

It is recommended that the pre-test respondents should resemble the target population and the pre-test should anticipate the actual circumstances in which the survey will be conducted (Fink and Kosecoff 1985; Converse and Presser 1986; Miller 1991) but that they should not be selected for the main survey (Statistics New Zealand 1995). Therefore the pre-test respondents were all GPs who had obstetric contracts, but were with a different secondary health care institution than for the major survey. The questionnaire was also tried on family and friends, and university IS staff (my supervisors) to remove major errors before being tried on the GPs. The pre-testing was conducted by the researcher, namely myself, in person with a list of open questions relating to the questionnaire design. This enabled me to see how the questionnaire would work in the field. This approach has been recommended by Converse and Presser (1986) and Miller (1991).

Although Converse and Presser (1986) consider that it isn't possible to examine all the questions in a participating pre-test, in this research project, all the questions were probed as the respondents were agreeable to such an approach. The changes suggested by the respondents in the pre-test were incorporated in an iterative manner until no new changes were suggested. All changes were checked with the following respondents to see if they should stay or be removed. As a result of the pre-test, several major changes in the questionnaire were made.

- 1) items added - responsiveness/speed, uses for an EMR to include research, audit, and teaching
- 2) items removed - First class network question as no-one knew what it was even though it is the RNZCGP bulletin board, and use of the bulletin board system was not considered essential in identifying computer experience
- 3) items modified - certain questions were modified in their wording to make the definitions clear and to prevent confusion in answering, one question (indicative

GP register) had ‘don’t know’ as an answer option added as requested by the respondents, the layout and order of the demographic questions were changed to prevent respondents missing out some questions and the use of filter questions made more clear

- 4) instead of all independent variables being considered in relation to each of user acceptance, usefulness, and ease-of-use, only the variables that had been shown in previous research or in the literature review to be directly related to each were considered. This shortened the questionnaire considerably, and removed the sense of ‘deja vu’ that respondents were experiencing in answering these three sections.
- 5) additional open questions were added to explore the respondent’s frame of reference for EMRs, and to permit the offering of additional information and attitudes in case not all information had been asked about in the questionnaire.
- 6) the mode of delivery was changed from a semi-structured face-to-face interview to a postal questionnaire. There were several reasons for this decision. All respondent GPs in the pre-test expressed a preference for postal questionnaires in general. They felt that the questionnaire required thought and they would prefer to do that in their own time and that having an interviewer sitting there with them created a source of pressure for them to finish the questionnaire regardless of their answers. They also felt that it would be more difficult to get access to interview a GP than to send the GP a questionnaire in the post and then if needs be chase up the non-responders. It took three weeks to gain access to a motivated group of ten respondents as most did not want to use consultation time, lunch time or after work to be interviewed. Only one agreed to an out-of-working hours visit. One could not find any time between work and home commitments to meet but was keen to help so requested that they be able to fill the questionnaire in at home when they had some time and mail it back. Two GPs were unable to complete the questionnaire in the time that they had allocated and also requested to be able to finish it at their convenience and return it by mail. Also, patient consultations took priority over the interview so two interviews had to be prematurely terminated and a follow-up arranged. This exposed a problem in organising a time to interview GPs, and in the unpredictability of them having the arranged time available on the day. A similar

problem has been identified by drug company representatives in gaining access to GPs time (personal communication). Attewell and Rule (1991) in their study of the impacts of information technologies in a representative sample of New York area businesses, found it took a research assistant working for 40 hours a week for more than 12 months to get access one manager in 80% of their target 200 firms (Attewell and Rule 1991). This research study did not have that amount of resources. Gutek (1991a) comments that in her study on sexual harassment, she found that telephone interviewing in the respondent's homes was cheaper and easier than face-to-face interviewing in the workplace. However, GPs treasure the privacy of their home telephone numbers and only one GP in the pilot study was keen to answer a questionnaire out of working hours at home. In summary, it was decided to risk the potential reduction in response rate of a postal survey (Miller 1991; McAvoy and Kaner 1996) in return for allowing the respondents to answer in their own time, without the pressure of an interviewer present, hopefully resulting in a greater accuracy of answers.

- 7) as a result of changing to a postal questionnaire, it was possible to include another target population as had been requested by the target population's primary health care organisation. They wanted to have the same information available on EMR access by midwives as well as their GP members. The initial target population of the research project was actually any one accessing an EMR and this was reduced due to time and financial constraints to GPs with obstetric contracts with the secondary health care institution. The addition of the midwives as a group to the research sample population assists the generalisability of the results as they are obstetric contract holders with the secondary health care institution thereby enlarging the sample population of obstetric contract holders. The only obstetric contract holders not being surveyed now are obstetric specialists working in primary care who are not employees of the secondary health care institution and as there were very few of these, they were also added to the target population. The addition of a non-GP group to the sample population makes it possible to analyse the data to see if GPs form a special sub-group in their responses. Hence, another hypothesis was

added, that GPs and midwives do not differ in their requirements for successful EMR access systems.

Each step was checked with potential respondents, the endusers of the results and the sponsors in order to reduce researcher bias and to ensure that the questionnaire was seen through the eyes of the respondents, and to ensure that it would suit the needs of the respondents, the endusers and the sponsors (Statistics New Zealand 1995).

The full questionnaire is included in Appendix 3. There were 4 changes to the questions in the final questionnaire for the second mailout, based on the feedback from the first mailout. These involved the addition of two questions relating to midwife participation and specialist participation in the implementation of the EMR in the section on user acceptance; the changing of the words 'GP' to 'primary health care professionals' and the addition of the question asking if the implementation of an EMR that primary health care professionals could access would have too many problems to be successful.

As it was a small pre-test, the responses were coded and the results checked and analysed by the data techniques used subsequently in the primary health care survey to see if any corrections needed to be made to the questionnaire and to check that the survey was going to be able to address the hypotheses (Converse and Presser 1986).

Thus, the pre-test of this research questionnaire consisted of both analysing the results of the questionnaire and the respondents' opinions and comments about the questions and the questionnaire.

Response rates:

Response rates are affected by the attitudes of the respondents to the research project (Chalsa Loo cited in Sieber 1982). The attitudes of an ethnic minority to the research project will be a function of three considerations - 1) the researcher's

purposes, procedures, attitudes, and relationship to the community, 2) the community's past experiences with research, and 3) the needs of the community and the attitudes of the community toward the variables to be studied, the intended outcomes of the study and the researcher (Chalsa Loo cited in Sieber 1982; McAvoy and Kaner 1996). The GPs in Wellington can be considered a community, in fact, GPs are often referred to as the medical community or as part of the medical community. Thus, GPs are more likely to participate if they are interested in the research topic, have been given adequate information about the topic and are given sufficient feedback (Lydeard 1996; McAvoy and Kaner 1996). However, response rates may be lower where the topic involves sensitive issues or is about subjects that lead the GP to feel that major changes in their work style may be needed (Springer and van Marwijk 1996).

Non-response can be due to: refusal to participate in the survey because of sensitivity of the questions, fear of the misuse of the information requested, length of the questionnaire, difficulty of the questions; wrong person approached, respondent does not understand the language of the questionnaire, illness, respondent unable to provide the information requested, inability to contact the respondent, or inaccuracy in the sampling frame (Statistics New Zealand 1995).

There can also be a partial non-response where the respondent provides some but not all requested information (Statistics New Zealand 1995).

Recommendations to improve response rates by GPs and respondents in general include giving GPs incentives to participate; having a known and respected medical colleague on the research team; improving the relevance of research and the quality of questionnaires; offer a policy of "constant reminders"; making the questionnaires as "local, personal or interactive as possible", with personal requests to participate; offering of a summary of the survey results; monitoring all research activities to ensure that practices are not overused and that such research projects that are considered are of a high standard and not repetitious; including a courteous, simple but informative covering letter, signing the letter by hand, including a reply-paid envelope, giving a guarantee of confidentiality; including some means of identifying

non-respondents; and finally piloting the questionnaire (Howie 1979; Chalsa Loo cited in Sieber 1982; Benbasat 1991; Danziger and Kraemer 1991; Lucas 1991b; Miller 1991; Statistics New Zealand 1995; McAvoy and Kaner 1996; Springer and van Marwijk 1996; Folz 1996).

Therefore, to increase the response rates for this research project the following were used:

1. having a known and respected medical colleague on the research team - the researcher is a GP and member of the RNZCGP but not from the survey area, and the director of the primary health care organisation is a well-known and respected local GP who personally signed the letters to the primary health care organisation members;
2. a series of friendly reminders were sent out
3. the questionnaire was made as "local, personal or interactive as possible", with personal requests to participate from the directors/senior managers of the primary health care organisation and the secondary health care institution;
4. a summary of the survey results was offered;
5. a courteous, simple but informative covering letter, signed by hand, including a reply-paid envelope was sent (c.f.: appendix 4);
6. a guarantee of confidentiality and anonymity was given;
7. the questionnaire was coded to provide a means of identifying non-respondents;
8. the questionnaire was piloted as discussed in the previous section

5.5 Research Design Summary

Cooper and Emory (1995) discuss that there are last eight different design perspectives to consider. These are applied, together with the unit of analysis from Zikmund (1994), to this research project.

1. The research project is both an exploratory and a formal study of the CSF for EMR access systems.

An exploratory study is appropriate where the area of investigation is new or vague, where important variables may not be defined or even known, and where it is not known what problems may develop in the course of the research (Cooper and Emory 1995). Variable identification is an important aspect of research design (Zikmund 1994). There is minimal published data on CSFs for EMR access systems, the important variables have not previously been defined and the research project is a first within New Zealand, as demonstrated in the literature search, hence it is appropriate for an exploratory design to be used for this research project. The first step in an exploratory study is secondary data analysis which is reported in the literature review.

A formal study has clearly stated hypotheses, and investigates the characteristics of a population, and discovers associations between different variables (Cooper and Emory 1995).

2. The method of data collection will be by a survey.
3. It is an ex post facto design as the variables are not manipulated.
4. The purpose of the project is descriptive, in that it is concerned with information obtained by a postal questionnaire (Miller 1991), and it addresses the ‘who, what, where, when, and how much’ of EMR access systems (Zikmund 1994; Cooper and Emory 1995). However there is some limited causal analysis. Cooper and Emory (1995) considers that causal analysis can include being concerned with understanding, explaining, predicting, and controlling relationships between variables. They discuss that causal analysis can occur with ex post facto design, and in fact is often the only feasible option, but warn that any conclusions must be interpreted with great care.
5. The research project is cross-sectional.

The cross-sectional study attempts to classify observations after the fact based on selected independent variables with the object of understanding underlying processes (Vitalari and Venkatesh 1991). Whilst pure cross-sectional research is

the weakest design for drawing causal inferences, as it only shows that two variables are correlated at a specific time (Lucas 1991b), cross-sectional research can provide causal inference, ‘given an appropriate logic of analysis and inquiry’ (King 1991 pg 292).

6. The scope of the research project is of a statistical survey, not case studies.
7. It is survey -based but uses field-study for the pilot testing.
8. The respondents will be aware of the research and hence the project will have to consider if this will have any influence on the reliability and validity of the answers received (Cooper and Emory 1995).

The unit of analysis is the individual respondent primary health care professional. The focus of this research project is on the beliefs, attitudes and concerns of individual GPs to EMR access.

Summary of Chapter Five

This chapter discusses the primary care survey design. It considers the formulation of the research design, the operationalisation of the variables, the identification of the sample, the design of the data collection instruments and the collection of the data.

The trade-offs between the various research methods were discussed. Secondary data analysis were used for the literature review and identification of potential variables, field work for the piloting of the survey, and survey research as a ‘methodology of verification’ of the results of the other research methods.

The design of the questionnaire incorporated existing instruments and measurement scales were they existed and were applicable to this research project. New questions were developed based on existing instruments and measurement scales to increase the reliability and validity of the survey results and the whole

questionnaire was designed using Dilman's principles of Total Design Method Dilman (1978).

The questionnaire structure and delivery was designed to maximise response rates. The survey questionnaire was piloted on a group of GPs who had obstetric contracts and were not with the same secondary health care institution as the GPs in the main survey. The questionnaire was also tried on family and friends, and university IS staff. The changes suggested by the respondents in the pre-test were incorporated in an iterative manner until no new changes were suggested. The pilot survey resulted in a variety of changes to the research design, the major changes being that a postal survey was selected as the data collection method within survey research rather than semi-structured interviews and that the target population was selected as the total number of all primary health care professionals eligible to be LMCs in the secondary health care institution region.

The next chapter discusses the results of the primary care survey.

Chapter Six - Primary Health Care Survey Data Analysis

This chapter presents the results of the primary care survey.

The results of the primary care survey are presented in the following section. The order of presentation is:

- response rates
- demographics of the GP respondents and comparison with New Zealand and Wellington GP demographics including GP practice and task computerisation
- midwife respondent demographics
- combined respondents results by occupation, age and gender, practice computerisation, computer training, computer experience,
- results for the EMR questions - user acceptance, ease of use and usefulness
- uses of an EMR
- access to the EMR data
- open questions relating to the meaning of an EMR
- obstetric information stored in an EMR

The presentation of the results will be followed by a discussion of the findings and their implications for the implementation of an EMR that could be accessed by primary health care professionals.

6.1 Response Rates:

170 questionnaires were sent out to doctors and midwives with obstetric contract agreements with the secondary health care institution, or who were eligible to be LMCs, or who felt they were eligible to be LMCs. There have been a total of 109 responses to the questionnaire on EMR Access, of which 103 are usable. 6 were returned for a variety of reasons, including no longer in the district, not in primary care, not in obstetrics, or declined to participate. This gives a total response rate of 64%, of which 94.5% were used in the data analysis. Thus the usable response rate was 61%.

Two non-usable responses belonged to members of primary health care organisation, and four non-usable responses to non-members with access to the secondary health care institution. These numbers are too small to analyse for differences between the ineligible responses.

The respondents can be divided into a number of groups:

- doctor/midwife
- primary health care organisation member /non-member but has secondary health care institution agreement
- male/female

The usable response rates:

for the doctor/midwife group were: 65%:59%

for the primary health care organisation member /non-member group were:
71%:41%

for the male/female group were: 65%:60%

The only group for which the respondents differ statistically is the primary health care organisation members/non-members (χ^2 test = 1.68E-06). However, the number of questionnaires sent out to each group was also different - 120 questionnaires were sent to the primary health care organisation members but only 39 to non-members. This is because the majority of the target population were members of the primary health care organisation.

6.2 Demographics:

General practitioner

There were male respondents 58%, female respondents 42%. The median year of graduation was 1980, 1976 for male GPs and 1983 for female GPs. This compares with a New Zealand GP distribution of 68% male GPs and a median year of

graduation of 1972 (NZMC 1995; RNZCGP database 1996) and 70% male GPs in the Wellington area (Stringer 1992).

There was no statistically significant difference between the type of respondent membership to the RNZCGP and the number of respondents on the Indicative GP Register as compared to the national GP workforce (NZMC 1995; RNZCGP Council newsletter 1996). But more respondents were either fellows or associates of the RNZCGP than the whole Wellington GP workforce (RNZCGP 1995a).

6% of respondents were in solo practice compared with a national figure of 22% in 1996 (RNZCGP database 1996) and a Wellington regional figure of 12% (Stringer 1992). This reflects the target population working in a large metropolitan area - 96% worked in either an inner-city or suburban practice. 74% of the RNZCGP database work in inner-city or suburban practices (RNZCGP databases 1995 and 1996).

There was a preponderance for large group practices with 54% having 5 or more GPs compared with a Wellington regional figure of 34%, and the average practice size was 4.6 GPs with a median number of 5 GPs.

75% of respondents worked full-time and 25% worked part-time. 50% of female GPs worked part-time compared with only 7% of male GPs. 83% were partners in their practice. 81% had extra medical qualifications beyond the basic medical degree, excluding RNZCGP membership, mainly the diploma of obstetrics (98%) and 20% had additional non-medical qualifications (78% BSc).

Thus, the respondents for this survey are more likely to have been in the medical workforce for a shorter length of time and to be members of the RNZCGP than the national median; to contain a greater proportion of female GP respondents than both the New Zealand and Wellington GP workforce; and to work in large group practices than the Wellington GP workforce.

With regard to practice computerisation, 45 respondents worked in computerised GP practices (96%). As many of the respondents worked in large group practices, it is foreseeable that some of these 45 practices are the same practice. Within these 45 respondents, there were only 34 GP respondents who personally used the computer (76%). The types of task that were computerised in the practices and used by a GP are shown below in table 2.

Task	Practice use %	number	GP use %	number
recalls	96%	43	53%	24
age-sex register	96%	43	56%	25
appointments	91%	41	64%	29
financial	87%	39	33%	15
letter writing	67%	30	47%	21
audit	67%	30	29%	13
disease register	64%	29	36%	16
prescriptions	62%	28	51%	23
laboratory results	51%	23	47%	21
clinical notes	51%	23	44%	20
e-mail/Internet	20%	9	7%	3
other	0%	0	0%	0

Table 2: Computerised tasks by practice and GP

Thus, the five most common tasks computerised are recalls, age-sex register, appointments, financial, and letter writing. 62% of GPs used a computer at home, the five most popular tasks were word processing (100%), spreadsheets (55%), e-mail and Internet usage (52%), games (48%) and financial management (45%).

There is a correlation between personal computer use and self-reported computer experience, it is stronger for personal computer use at work ($r=-0.54$ for personal use at work, and -0.32 for personal use at home). There is also a slight correlation between practice size and computerisation ($r=-0.32$).

There was no correlation between practice computerisation and RNZCGP ($r=0.14$) or Indicative General Practitioners register membership ($r=-0.08$).

Midwives

In comparison to the GP respondents, 98% of midwives respondents were female. The median year of nursing graduation was 1974, and the median year of commencing midwifery practice was 1980. 20% had extra nursing qualifications (80% Advanced Diploma of Nursing and 40% Bachelor of Nursing). However, there was no statistical difference between the doctor group and the midwife group with regard to age, year of graduation, year commenced in practice, practice type, or practice workload (using Anova analysis of means). 88% worked in inner-city or suburban practices. 16% worked in practices with GPs. 29% worked in solo practices, and the majority (43%) worked in 2 or 3 midwife groups. 31% had had computer training, 44% at a polytechnic. 67% worked full-time. 33% worked in computerised practices, of which 29% were GP practices. 25% were partners, with 20% worked in other arrangements than the traditional GP practice contracts of partner, associate or assistant. Most of these other arrangements were essentially solo practices working together to provide locum cover and backup.

Midwives used the computer at 82% of the computerised practices but all used a computer at the secondary health care institution (the PIMS system) if they attended deliveries on the secondary health care institution premises.

51% of midwife respondents used a computer at home, including 55% of those midwives who did not work in computerised practices. There is a correlation between midwife personal use of a computer at work ($r=-0.42$) and at home ($r=0.65$) and self-reported computer experience. This is the reverse of that for GP, as the use of computers at home has a stronger correlation with computer experience for midwives than for GPs. There is also a very slight correlation between practice size and midwife computerisation ($r=-0.27$). Within regard to task computerisation, the five most computerised tasks were letters, financial, clinical notes, e-mail and Internet. Clinical notes were used by 41% of computerised midwife practices.

Thus, compared with GPs, midwives had an earlier year of nursing graduation, were mainly female, were more likely to work in solo practices or in small practices

of 2 or 3 midwives, were more likely to have had computer training but less likely to work in computerised practices. They had a slight decreased use of computerised clinical notes.

Obstetric specialists

The number of responding obstetric specialists was too small to allow for any meaningful statistical analysis, therefore they were combined with the GP respondents for further analysis.

Occupation:

The respondents have been analysed by occupation, gender and age below. Combining the specialists with the GPs gives two groups of equal size - doctors 52, and midwives 51. The results are shown in table 3.

R e s p o n d e n t s b y O c c u p a t i o n	
O c c u p a t i o n	N u m b e r
G P	4 7
S p e c i a l i s t O b s t e t r i c i a n	5
M i d w i v e s	5 1
T o t a l	1 0 3

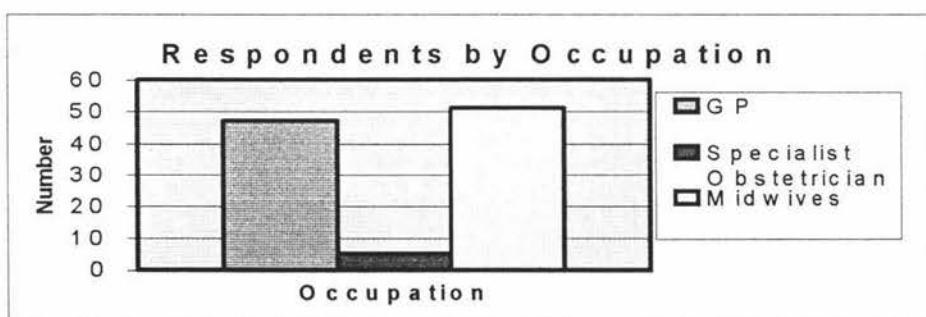


Table 3: Respondents by occupation

Age and gender:

The total respondents' age by occupation and genders form a normal distribution. However, this is affected by two different factors. Female doctors tend to be amongst the younger age groups. 85% of female doctor respondents are < or = 40 years of age, compared with only 31% of male doctor respondents. The second

factor is that there is only one male midwife. Thus the total female group is made up of 50 midwives but only 20 doctors, so the female age distribution is affected more by the midwife age distribution than by the female doctor age distribution.

Respondents by Occupation, Gender and Age

Occupation	Gender	25-30	31-35	36-40	41-45	46-50	51-55	56-60	61+	Total
Doctor	Male	0	1	9	7	7	3	2	3	32
	Female	0	5	12	0	2	0	1	0	20
Midwife	Male	0	1	0	0	0	0	0	0	1
	Female	0	2	11	15	12	7	2	1	50
Total	Male	0	2	9	7	7	3	2	3	33
	Female	0	7	23	15	14	7	3	1	70

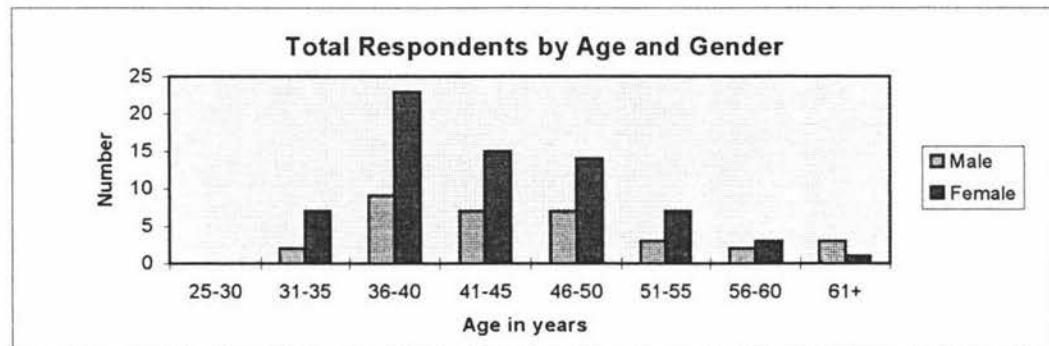
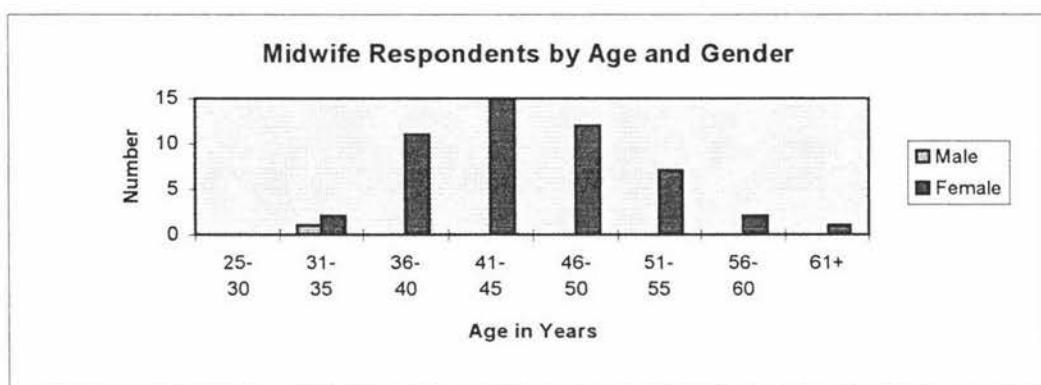
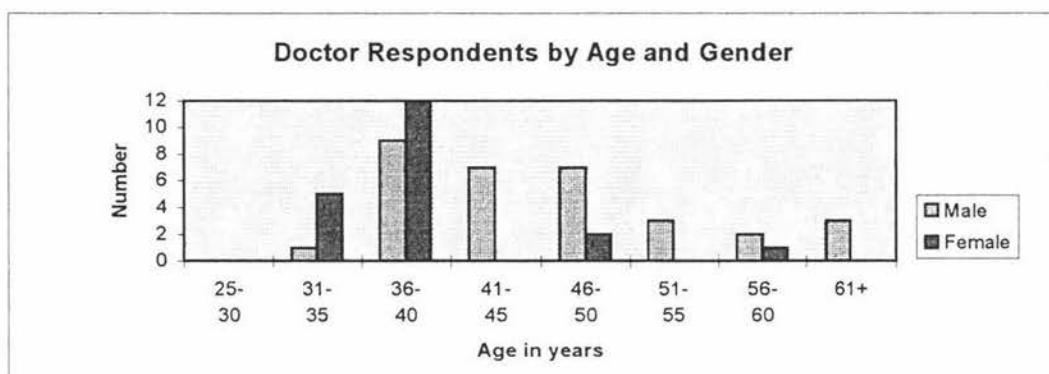


Table 4: Respondents by age and gender

Practice computing:

The number of practices which used computers to any extent was analysed by occupation, and age, gender, and primary health care organisation membership of all respondents. RNZCGP and Indicative GP register membership were analysed under the section headed general practitioners.

There was no correlation between computerisation of practices and age and only a slight correlation between practice size and computerisation ($r=-0.32$ for GPs and $r=-0.27$ for midwives). There was no correlation between gender and GP ($r=-0.08$) or midwife ($r=-0.1$) practice computerisation, however, there was a slight correlation between all respondents gender and all practice computerisation ($r=0.35$). This result is not statistically significant (chi-squared test) and may be explained by the greater overall number of female respondents (68%) due to the number of female midwives.

There is a slight statistically significant relationship between the primary health care organisation membership and practice computerisation (chi-squared =0.0027) in favour of non-membership but the result is not a strong correlation ($r=-0.12$). This result may be due to the unequal number of primary health care organisation member and non-member respondents so that a small increase in the number of computerised practices amongst non-members achieves statistically significance but is not a true reflection of the relationship between primary health care organisation membership and practice computerisation.

However, there was a statistically significant difference between the number of computerised doctor practices and computerised midwife practices ($p<0.0005$ by chi-test; χ^2 test = 2.42E-11) with a strong correlation ($r=0.63$). 92% of doctor practices were computerised. The very small number of non-computerised precluded any meaningful data analysis for differences between computerised and non-computerised doctor practices. Only 33% (17) of midwives stated that their practices were computerised. Computerised midwife practices were more likely to work without any doctors in their practice (47%:33%), to work with other

midwives (76%:67%), to be a partner in their practice (35%:21%), not to be computer trained (17%:40%), to use the computer at work and at home, not to be a member of the primary health care organisation (60%:27%), to have graduated as a midwife prior to 1970 (35%:24%) and to have a self-reported computer experience level of none or a little extent (55%:29%). There was no difference in age or the presence of extra qualifications between the computerised and non-computerised midwife practices. The numbers, however, are really too small to draw major conclusions about the factors affecting midwife computerisation. A much larger survey of midwives would be needed to ascertain the factors that affect midwife computing.

Practices with computers by occupation of respondents

	Doctors	Midwives	Total
Yes	48	16	65
No	4	33	37

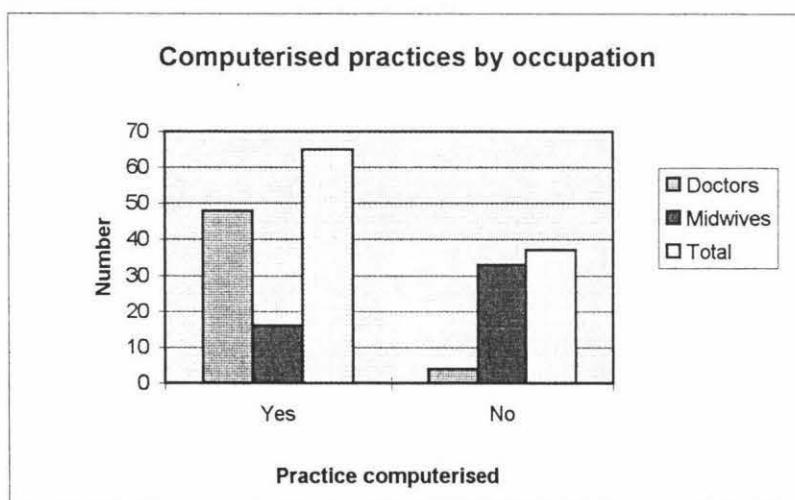


Table 5: Practice computerisation by occupation

Computer Training:

Analysis of those with previous computing training showed that only 7 doctors and 16 midwives had had any formal computer training. The numbers were too small for meaningful analysis.

Previous Computing Training	
Yes	No
23	77

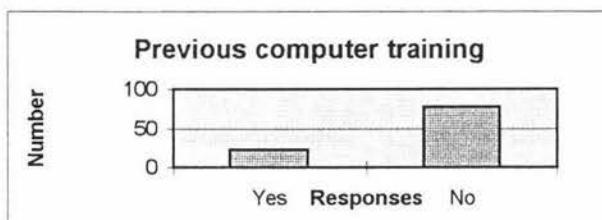


Table 6: Computer training

4 male doctors and 3 female doctors had had some training, whereas all the midwives with some training were female (not surprising since there was only one male midwife respondent). The age distribution was spread throughout the years with 11 under 45 years of age and 12 aged over 45 years. There was no correlation between age and computer training.

Computer experience:

Another variable proposed to affect computer use is self-reported computer experience. Thus, the respondents were analysed by computer experience based on self-reported belief in their ability to handle certain computer tasks, on a scale from 1=none to 5-to a great extent.

There was a significant difference between self-reported computer experience and occupation, (doctor mean = 3.08, midwife mean = 2.53, $p=0.007$) but the strength of the association was only slight (correlation coefficient $r = -0.2984$).

There was a substantial correlation between personal computer use and self-reported computer experience. For GPs, the correlation was $r=-0.54$ for personal use at work and $r=-0.32$ for personal use at home. For midwives, the correlations

were reversed, being stronger for personal computer use at home ($r=-0.65$) than at work ($r=-0.42$).

There was no correlation between age and self-reported computer experience (correlation coefficient = -0.11169) or gender and computer experience (correlation coefficient = -0.1603).

There was no correlation between self-reported computer experience and user acceptance ($r=0.01/0.02$), perceived ease of use ($r=0.06$) or perceived usefulness ($r=0.03/0.04$) or wanting to be consulted about using an EMR ($r=0.05$).

Computer Experience by Age

Age	Level of Computer Experience				
	1	2	3	4	5
31-35	1	5	2	0	1
36-40	3	5	11	9	3
41-45	1	10	9	2	0
46-50	1	3	12	3	2
51-55	3	2	3	1	1
56-60	1	1	3	0	0
61+	0	3	1	0	0
Total	10	29	41	15	7

Self-reported Level of Computer Experience by Age

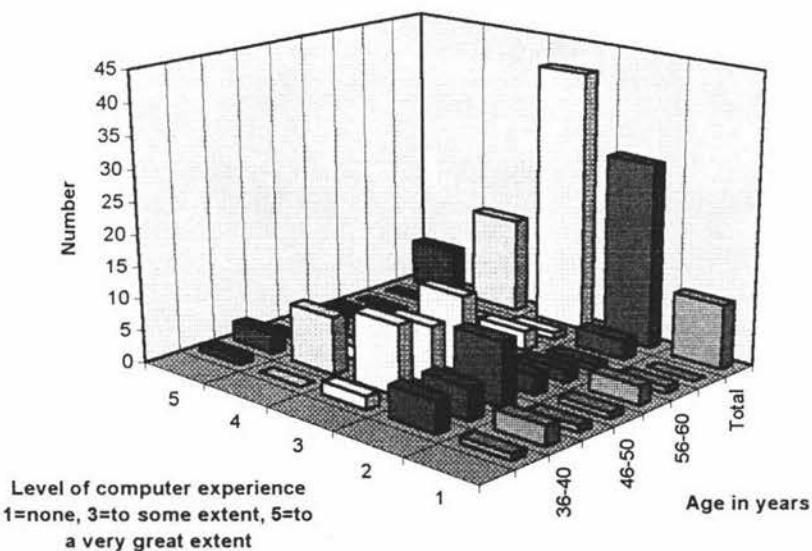


Table 7: Self-reported level of computer experience by age

6.3 Electronic Medical Record Use:

The following data analysis is based on all respondents. The reason for analysing the EMR use section of the questionnaire by total respondents rather than by doctor and then comparing the results with midwives was to increase the generalisability of the results by widening the target population analysed. Where there are statistically different results between doctors and midwives, these have been highlighted.

Computer Use:

The first section addresses the variables of user acceptance, ease of use and usefulness of an EMR. These were identified in the theoretical model as the major variables related to EUC Success.

‘Choiceuse’(Choice of use) and ‘agreeuse’ (agree to use) measure ‘user acceptance’. ‘Easyuse’(easy to use) measures ‘perceived ease of use’. ‘Impwuse’ (improve work performance) and ‘advuse’ (offer work advantages) measure ‘perceived usefulness’.

‘Conuse’ (I or my profession consulted) measures the importance of consultation in ultimate computer use. Using ANOVA to compare the means of these 6 groups:

Groups	F	Fcrit	P-value
with all 6 groups	3.747356613	2.229374019	0.00239
without ‘agreeuse’	2.461318	2.390166	0.044534
without ‘agreeuse’ and ‘choiceuse’	1.09095	2.627786	0.352774

Table 8: Variables of user acceptance, ease of use and usefulness of an EMR

As the elimination of two groups results in the loss of any statistically significant difference between the means of the remaining groups, the difference in the means between these 6 groups can be attributed to these first 2 groups of ‘choice’ and ‘agree to use’. As they have the higher mean value, the more important variables affecting EUC success are those of ‘ease of use’, ‘usefulness’ and ‘consultation’.

However, user acceptance cannot be forgotten as the means of the two groups representing user acceptance are 4.25 and 4.14, with 79% of all respondents agreeing that it is important to them that they have a choice about using an EMR, and that they would be more likely to use an EMR if they agreed to use it rather than being told to use it.

Variable	Disagree	Uncertain	Agree	Total	Mean
Easy to use	4	3	94	101	4.59
Offer work advantages	3	4	94	101	4.57
Improve work performance	3	7	90	100	4.5
I or my profession consulted	4	9	87	100	4.39
Choice of use	8	13	81	102	4.25
Agree to use	13	7	81	101	4.14

Table 9: User acceptance, ease of use and usefulness of an EMR by response

Slightly more doctors considered agreeing to use an EMR and having a choice about using an EMR to be important to them than did midwives but the difference was only significant at the 0.05 level ($p=0.02$) and was not supported by the question relating to ranking of these variables.

There was no statistical difference between the answers supplied by doctors and that by midwives for the perceived usefulness, ease of use or consultation.

Ranking of user acceptance, ease of use and usefulness:

The next section of the questionnaire analysed user acceptance, perceived ease of use and perceived usefulness by asking the respondents to rank in order of preference: choice, ease of use, and benefits exceeding the costs of computer use.

Using ANOVA to analyse the means of the three groups, revealed that there is a statistical difference between the three ($F=10.88$, $F_{crit}=3.03$ and $p\text{-value}=2.77E-05$). Again, it was the question addressing user acceptance that was causing the difference. The lower the mean, the greater the number of respondents who ranked it the most important variable.

Variable	1st	2nd	3rd	Total	Mean
Easy to use	57	28	13	98	1.55
Benefits exceed costs	55	23	19	97	1.63
Choice	33	28	37	98	2.04

Table 10: Ranking of user acceptance, ease of use and usefulness

32% of all respondents felt that having a choice about using the EMR was the most important variable in making their decision whether to use an EMR. However 58% of respondents felt that easy to use was the most important variable, and 57% felt that the benefits exceeding the costs was the single most important variable for them. The numbers exceed 98, as 16% of the respondents ranked all three variables as equal first.

The order of variables resulting from the questions relating to computer use is confirmed by the ranking questions - perceived ease of use, followed by perceived usefulness, then user acceptance.

There was a difference in the ranking of these variables between midwives and doctors. More doctors ranked 'benefits exceed costs' ahead of 'easy to use' whereas midwives ranked 'easy to use' ahead of 'benefits exceed costs'. The differences were only significant for 'ease of use' ($p<0.001$, $p=9.2E-07$) and for 'choice' ($p=0.03$).

Variable	doctor mean	midwife mean	total Mean
Easy to use	1.86	1.19	1.55
Benefits exceed costs	1.56	1.72	1.63
Choice	2.22	1.85	2.04

Table 11: Ranking of user acceptance, ease of use and usefulness by occupation

When would an EMR be used:

The variables affecting computer use addressed in this section were those of costs and benefits.

Only 34% of the total respondents would use an EMR under a work contract regardless of any demonstrable benefits. Thus, the absence of any demonstrable benefits from EMR use is a barrier to successful EMR use, with 32% of respondents answering that they would refuse to use an EMR with no demonstrable benefits, even if it was part of a work related contract. Thus, even if it was a contractual requirement that the EMR was used, some respondents would use personal choice and refuse to use the EMR. The questionnaire did not address the degree to which the respondents would refuse to use the EMR.

The personal costs of using an EMR are of even greater concern than benefits to the respondents, only 20% of respondents would use the same EMR without any regard to the costs to themselves with some respondents commenting separately on this issue. There were statistically significant differences between the answers in this section for doctors and midwives. Considering that fewer midwives than doctors have computerised practices, it is foreseeable that they may have more concerns about personal costs. However, this was not borne out in the answers - fewer doctors would an EMR regardless of costs than would midwives ($p<0.01$). Similarly, fewer doctors would use an EMR regardless of any demonstrable benefits, than would midwives ($p<0.05$). More doctors would refuse to use an EMR with no demonstrable benefits, even it is was part of a contract than would midwives ($p<0.05$).

Part of a contract	doctor mean	midwife mean	total Mean
use an EMR regardless of benefits	2.43	3.04	2.75
use an EMR regardless of costs	1.90	2.63	2.26
refuse to use the EMR with no benefits	3.37	2.65	3.05

Table 12: Benefit and cost components of a contract

The higher the mean score, the more respondents who agree with the statement.

With regard to the demonstrable benefits that an EMR may have, respondents were asked about the various groups to whom these benefits may be directed and whether this would affect their use of the EMR.

Respondents were more likely to use an EMR with benefits for:

Variable	Disagree	Uncertain	Agree	Total	Mean
Patients	0	8	90	98	4.33
Myself	4	11	83	98	4.11
Any benefits	6	9	83	98	4.25
Organisation	26	42	30	98	3.00

Table 13: Types of benefits of an EMR

Using ANOVA, the variable that causes a difference in the group means is that of benefits relating only to the organisation. As shown in the above chart, considerably more respondents would use an EMR with demonstrable benefits for themselves and/or their patients than would use an EMR that only had demonstrable benefits for the organisation. There was no difference between the answers supplied by doctors and by midwives relating to the type of benefits.

User acceptance:

User acceptance is defined as the respondent accepting the EMR and being willing to use it. Fourteen features of an EMR system were analysed for their importance in the decision to accept an EMR.

Variable	Disagree	Uncertain	Agree	Total	Mean
data is easily and quickly retrievable	3	3	96	102	4.62
accurate and factual data	4	5	93	102	4.50
secure and confidential data	5	4	93	102	4.50
perceived personal cost	4	5	93	102	4.47
patient consent	6	18	77	101	4.15
realistic management	5	15	80	100	4.05
expectations and relationships					
obvious ownership of data	9	22	68	99	4.00
a personal approach from a profession member	7	14	81	102	3.99
the level of management support from the secondary health care institution	9	22	69	100	3.88
acceptable in court	11	21	69	101	3.81
personal computer experience	13	15	73	101	3.78
GP representative in implementation	20	27	51	98	3.47
Midwife representative in implementation	8	10	20	38	3.32
Obstetrician representative in implementation	7	16	9	32	3.09

Table 14: Variables related to user acceptance

The top five most important variables in the decision to agree to use an EMR are thus:

- the data is easily and quickly retrievable
- the data is accurate and factual
- the data is secure and confidential
- perceived personal cost
- patient consent

The only variables related to user acceptance that there is a statistical difference between doctors and midwives were with regard to the representative who participates in the development of the EMR. Each group would rather have a member of their own profession, ie.: GP would rather have a GP represent them ($p<0.01$), and midwives would rather have a midwife represent them ($p<0.01$). There were too few specialist respondents to analyse for their preference.

Support and Training:

Support refers to ongoing assistance with using the EMR. Training refers to learning how to use the computer and the EMR. Respondents were asked to what extent support and training provided by the secondary health care institution, the primary health care organisation, or other vendors would impact on their decision to use the EMR. There was a clear distinction between the answers from the members and the non-members of the primary health care organisation. There were 85 primary health care organisation members and 18 non-members in the eligible respondents.

Variable	Disagree	Uncertain	Agree	Total	Mean
Primary health care organisation members:					
Support by the primary health care organisation	2	6	75	83	4.31
Support by the secondary health care institution	7	19	57	83	3.85
Support by Vendors	10	36	37	83	3.43
Training by the primary health care organisation	3	9	72	84	4.29
Training by the secondary health care institution	9	19	55	83	3.81
Training by vendors	10	34	39	83	3.51
Non-primary health care organisation members:					
Support by secondary health care institution	0	2	15	17	4.41
Support by vendors	2	5	10	17	3.77
Support by the primary health care organisation	3	6	8	17	3.41
Training by the secondary health care institution	0	3	14	17	4.29
Training by vendors	3	4	10	17	3.6
Training by the primary health care organisation	4	5	8	17	3.24

Table 15: Sources of support and training

Primary health care organisation members would be more likely to use an EMR if the support is provided by their organisation, with the secondary health care institution a second choice, whereas the non-primary health care organisation

members want support by the secondary health care institution, and would rather have support by vendors than by the primary health care organisation.

Non-members of the primary health care organisation would be more likely to use an EMR if training is provided by the secondary health care institution, whereas the primary health care organisation members would prefer training provided by their primary health care organisation.

Respondents were asked to rank their preferences for the sources for support and training.

Variable	1	2	3	Total	Mean
Primary health care organisation members					
Support by the primary health care organisation	53	16	4	73	1.33
Support by the secondary health care institution	12	31	28	71	2.23
Support by vendors	10	22	38	70	2.40
Training by the primary health care organisation					
Training by the primary health care organisation	57	16	5	78	1.33
Training by vendors	15	24	35	74	2.27
Training by the secondary health care institution	7	33	34	74	2.37
Non-primary health care organisation members					
Support by the secondary health care institution	11	2	2	15	1.4
Support by vendors	4	6	3	13	1.92
Support by the primary health care organisation	0	6	7	13	2.54
Training by the secondary health care institution					
Training by the secondary health care institution	12	2	2	16	1.38
Training by vendors	4	7	3	14	1.93
Training by the primary health care organisation	0	6	8	14	2.57

Table 16: Ranking of sources of support and training

The lower the mean in the ranking results, the more respondents rated that variable as the preferred option. Thus, the ranking question supports the difference between the primary health care organisation members and non-primary health care organisation members and thus increases the validity of these questions.

The majority of the primary health care organisation members (72%) would prefer support and training to be provided by their primary health care organisation, whereas 80% of non-members would prefer the support and training to be provided by the secondary health care institution.

Perceived Usefulness:

The questionnaire asked respondents 11 questions about benefits of an EMR system that would make them more likely to use it.

Variable	Disagree	Uncertain	Agree	Total	Mean
Decrease workload/pressure	1	2	96	99	4.71
Meets goals/needs of yourself, patients, practice, population	0	4	95	99	4.69
Enabled me to work quicker	1	3	96	100	4.68
Made my job easier	1	2	97	100	4.67
Assist in improving quality of patient care	1	4	95	100	4.66
Protect against medical litigation	0	6	94	100	4.63
Improves communication and information sharing	0	7	93	100	4.59
Assist in improving seamlessness of care	0	9	91	100	4.55
Accessed from different systems	4	15	80	99	4.34
Accountability for changes made to the EMR	2	21	77	100	4.20
Flexible to individual user styles	3	17	80	100	4.16

Table 17: Variables related to perceived usefulness

The top five most important features of an EMR that would make the respondents more likely to use the EMR are thus:

- Decreased my workload/pressure
- Meets goals/needs of myself, patients, practice, population
- Enabled me to work quicker
- Made my job easier
- Assists in improving quality of patient care

However, all the features scored highly, with a mean of greater than 4.16, and thus cannot be excluded from consideration. There were no statistical significant differences between doctors and midwives in their responses to this section.

Perceived Ease of use:

This section addressed the features of an EMR system that would make it easy for respondents to use.

Variable	Disagree	Uncertain	Agree	Total	Mean
Clear and understandable	0	1	99	100	4.89
Easy to remember how to use	0	1	98	99	4.81
Unlimited access/availability	2	2	95	99	4.78
Easy to become skilful at use	1	2	97	100	4.75
Easy to learn	2	2	95	99	4.64
User friendly interface	0	7	93	100	4.63

Table 18: Variables related to Perceived Ease of use

All these features scored very highly.

The requirement that the EMR is clear and understandable is supported by extra comments written by respondents asking for lots of 'help' features so that they do not need external help in using the system.

The need for the EMR to be accessible at need rather than at set times was also highlighted in the extra comments written by respondents. Some respondents

requested that access be not just physical access to the EMR in the hospital setting but also via modem from the practice location and even from home.

There were no statistically significant differences between the doctors and the midwives responses in this section.

EUC success

The low rating for personal computer experience in the section on user acceptance is supported by the lack of any correlation between self-reported computer experience and user acceptance ($r=0.01/0.02$), perceived ease of use ($r=0.06$) or perceived usefulness ($r=0.03/0.04$). Thus, self-reported computer experience is not an independent variable ultimately affecting EUC success.

Similarly, there was no correlation between age, gender, occupation, practice size or existing use of computerised clinical records and user acceptance, perceived ease of use and perceived usefulness, thus these are not independent variables affecting EUC success. The presence of any correlation between practice computerisation, RNZCGP membership, practice type and computer training was not analysed as there were too few respondents in the alternate groups (ie.: there were too few practices that were not computerised). Membership on the Indicative GP register had no correlation with user acceptance or perceived ease of use, and only a very slight negative correlation with perceived usefulness ($r=0.2$). Part-time work had a very slight correlation with wanting to be consulted about using an EMR ($r=0.24$).

Uses of an EMR:

As there are many potential uses for the data contained within an EMR, and many groups of people that may wish to access that data, respondents were asked their opinions regarding the use to which the data contained in the EMR should be put.

Variable	Disagree	Uncertain	Agree	Total	Mean
Data uses:					
Clinical patient care	0	10	89	99	4.58
Audit	9	20	71	100	3.93
Research	11	16	73	100	3.90
Clinical teaching	12	22	66	100	3.78
Medico-legal purposes	12	32	55	99	3.65
Administration - bed/staff numbers	18	30	51	99	3.46
Financial - budgeting/contracting/ managed care	18	33	48	99	3.44

Table 19: Uses for which an EMR can be accessed

Clinical patient care was the only use for which there was no disagreement.

Administration and financial uses of data contained within an EMR were the two areas of greatest disagreement, reaching 30% for financial considerations. The only question in this section where there was a statistically significant difference in the results was that the information contained within an EMR should be used for medico-legal purposes. More midwives agreed with this statement than did doctors but the difference was only significant at the 0.05 level ($p=0.036$).

Access to the EMR data:

Respondents were asked 4 questions relating to access to data.

Variable	Disagree	Uncertain	Agree	Total	Mean
Access to the EMR data:					
Different levels of access for different groups of people	3	8	88	99	4.47
Certain information should be 'hidden' from general access	7	6	88	101	4.52
Anyone with legitimate reason could access any data	50	26	24	100	2.53
Only health professionals should have access to data	16	23	62	101	3.81

Table 20: Access to an EMR

When the question was asked, that anyone with any legitimate reason could access any data that they felt relevant for their reason, the majority disagreed and felt that access should be restricted in some way. Most respondents (89%) felt that there should be different levels of access for different groups of people such as health professionals, administrative staff, etc. Similarly, 89% of respondents felt that certain information should be kept ‘hidden’ from general access. However, only 60% of respondents felt that only health professionals should have access to the data in an EMR.

However, there were statistically differences between doctors and midwives in this section. The only question for which there was no difference was that only health professionals should have access to an EMR.

Access	doctor mean	midwife mean	total mean
Different levels of access for different groups of people	4.67	4.49	4.47
Certain information should be ‘hidden’ from general access	4.78	4.24	4.52
Anyone with legitimate reason could access any data	2.16	2.96	2.53
Only health professionals should have access to data	3.65	3.96	3.81

Table 21: Access to an EMR by occupation

More doctors felt that there should be different levels of access for different groups of people, and that certain information should be ‘hidden’ from general access. More midwives felt that anyone with a legitimate reason to access the EMR should be able to do so, but the majority of midwives did not agree or were unsure about this.

What does an EMR mean to you?

This was an open question giving respondents an opportunity to elaborate on what an EMR meant to them. There were a wide range of answers. The majority related to an expected increase in the level of work as they came to grips with the

hardware and software involved in accessing the EMR. Most felt that it would be worthwhile eventually but were concerned about the personal time investment and financial cost. Some respondents did not feel that they would be able to afford access to the EMR.

Some respondents, especially those whose practices were fully computerised already, were looking forward to such a development and felt that it was a step in the right direction. Others felt very threatened and hoped that it would never eventuate. Some midwives felt that it was a pity that nursing had lowered to a level of pushing buttons and some doctors felt that such progress is very rarely necessary for good patient care.

85 respondents made comments regarding what an EMR meant for them, this was decided equally between doctors and midwives - 43 doctors and 42 midwives.

The major concerns regarding an EMR for midwives were:

- the initial time and cost required to learn the system
 - the level of support and training provided
 - the cost of setting up both financial and time
 - needs capital investment
 - will decrease time spent with patients
- a major hurdle to overcome
- confusing to start with
- could decrease the paperwork but doesn't believe that will decrease paperwork
- will increase workload as need to keep paper records as well
- feels intimidated by technology
- doesn't need any more challenges at the moment
- the data is only good if correctly entered
- more work for midwives if the doctors don't enter the data themselves
- how to control privacy and security
- needs to be foolproof and easily fixed if breaks
- what happens if the system is 'down'

- would need a laptop and have enough to carry around as it is
- system needs to be accessible at all times, and needs to have modem access
- some were uncertain about what an EMR would mean to them

Midwives did have many positive comments to make about an EMR:

- would decrease paperwork
- make data more accessible and could be used for other purposes such as research
- useful to a certain extent
- would stop repetitious form filling
- is an essential component of modern practice
- improve information flow
- a welcome challenge
- would be okay if was easy to use with adequate support

The major concerns regarding an EMR for doctors were:

- increase workload and cost
 - for upskilling and to enter data
 - decreases time spent with patients in the consultation
 - increase in frustration and a lot of hassle
 - more chaos and unnoticed errors
 - major disruption
 - needs committed users for the data to be accurate and useful
 - must not detract from personal communication
 - contains poorer clinical notes than manual systems due to lack of time and/or skill in using the EMR
 - the quality of the software would dictate the success of the system
 - training very important
 - consumes lots of paper
 - is full of useless information and increase the need for more useless information
 - a lot of work for very little personal gain

- entering the era of ‘big brother’ watching us’
- there were grave concerns regarding security, privacy, accuracy, uses of the information, access by people outside the practice, multiple users and from multiple sites and what guarantees exist preventing access from other agencies such as the Police, or Income Support Services
- grave concerns regarding illicit / illegal access
- easily mismanaged into a costly, time consuming mess so requires planning
- would need to interface with existing GP information systems as many GPs use clinical notes now
- needs an user interface in the form of ‘boxes’ of data
- an unwanted challenge
- have moved practice style to get away from EMR
- something hoped never to see as such progress is very rarely necessary for good patient care

The positive comments made by doctors about an EMR were as follows:

- have used an EMR for years and would feel vulnerable without it, and that the benefits definitely outweigh the disadvantages
- will result in an improvement in communications, better information, decreased replication of paperwork, testing, efficient data access and record keeping but not a decrease in paperwork
- will be useful if data entered correctly
- a welcome challenge
- has many advantages provided it was a well designed system but existing GP EMRs have problems with quickly accessing information especially about past consultations and problem lists
- accepts it may be a necessity of working with the system
- feels anxious about using an EMR but would consider it an achievement if managed it
- feels it is inevitable and the way of the future

In general, the doctors and midwives who made the more positive comments regarding the ER, tended to rate higher how keen they were to use an EMR and had a lower level of apprehensiveness. However, many midwives and doctors with concerns about the EMR were also keen to use one. Some of the midwives and doctors who reported extensive experience with computers had more concerns than the other respondents, this may be because they have more experience on which to base their comments.

45% of respondents were apprehensive about using an EMR, 51% were keen to use an EMR and 15% were both keen to and apprehensive about using an EMR.

There was no correlation between occupation and attitude towards the EMR (keen to use $r=0.23$, apprehensive $r=0.106$), or between RNZCGP membership (keen to use $r=-0.04$) or Indicative GP Register membership (keen to use $r=0.02$). This agrees with Thakurdas et al (1996) who found no correlation between Indicative General Practitioners Register membership and attitudinal and behavioural responses to computerisation.

Less than 10% of respondents felt that implementing an EMR that primary health care professionals could access would be waste of time and money although 30% of a smaller sample of 30 respondents felt that there would be too many problems for such an implementation to be successful.

Obstetric information stored in an EMR:

The sample population for this research survey were those doctors and midwives who are eligible to be lead maternity carers under 1996 Section 51, some also provide secondary/tertiary obstetric care. In order to identify potential areas of difficulty with regard to the specific patient information, respondents were asked about what information relevant to the practice of obstetrics should be transferred to an EMR, and what information, if any, should be withheld.

The majority of respondents (94%) felt that clinically relevant obstetric information should be stored within the EMR, although what constitutes such information was not defined. 92% of respondents also felt that past medical and surgical history should be transferred to an EMR. Fewer respondents felt that the increasingly personal and sensitive information concerning personal details, such as marital status, alcohol and drug usage, etc (71%), details of mental health consultations (68%), sexual health consultations (63%) and details regarding termination of pregnancies (61%) should be transferred. There was no difference between the responses from doctors and from midwives, in fact there was remarkably close agreement in the mean scores for each answer.

36% of respondents felt that there was information that they considered necessary for the practice of obstetrics that should not be transferred to an EMR. When asked for details regarding which information should not be transferred, most respondents stated the areas of sexual health, mental health, sexual abuse, previous termination of pregnancies, certain personal and social details such as living arrangements and drug usage, plans for adoption, and any information that the patient did not want transferred to the EMR.

When asked if it would pose a difficulty for them if it was a requirement that any information that was given to the secondary/tertiary care health institution was entered on the EMR, 33% of respondents felt it would pose a difficulty for them. Of these 33% respondents, only 3% would refuse to use the EMR completely, 83% would transfer only limited information, and 80% would transfer limited information but back it up by passing on extra information with a telephone call or in person. Only 25% of respondents, who had difficulty with all information being entered on the EMR, would transfer all necessary information. There was no difference between doctor and midwife responses in this section.

In summary, a third of all respondents believe that some information should not be stored within an EMR, a third would have difficulty if all information was to be stored and 75% would transfer only limited information or refuse to use the EMR

at all. This has implications on the completeness of the information contained within the EMR and may impact on clinical decision making if this withholding of certain information is not considered. Another option would be to ensure that security and access to data was so controlled that both health care professionals and patients were agreeable for all information to be entered. However, given the major concerns expressed by the respondents in this survey with regard to security, privacy, confidentiality, access, and the uses of the information held within an EMR, such levels of control, even if they existed, are unlikely to be believed.

Chapter Seven - Hypotheses and Model Testing

This chapter takes the results of the primary health care survey from chapter six, tests the hypotheses presented in chapter four and reports on the theoretical model development.

7.1 Hypotheses Testing

A hypothesis is a statement of belief used in the evaluation of population means. A null hypothesis is a claim that there is no difference between the population mean and the hypothesised value (Kuzma 1984).

If there were no influence of the proposed variables on EUU success and the surrogate measures, the value of the mean for each variable would be 3, the middle value of the Likert scale 1-5. Thus, the null hypothesis for each of the hypotheses 1-8 is that there is no statistical difference between the population mean determined from the answers on the questionnaire and the hypothesised mean of 3.

For hypotheses 1-8, the results of the t-test and ANOVA are that both the t value and the computed F value for the difference between the null hypothesis mean and the actual mean exceed the critical t value and F value at the level of 0.01 probability, so these null hypotheses are rejected (Kuzma 1984; Fink and Kosecoff 1985; Folz 1996;). ANOVA cannot prove directly that there are differences amongst groups, it can only test the null hypothesis (Fink and Kosecoff 1985). The t-test allows the comparison of two groups to determine the probability that any differences between them are real and not due to chance (Fink and Kosecoff 1985).

Hypothesis 1:

User acceptance influences EUU success, separate to perceived ease-of-use and perceived usefulness.

The support for this hypothesis comes from the rejection of the null hypothesis that user acceptance has no effect on EUC success, the number of respondents who ranked user acceptance as the most important variable in their decision to use an EMR, and the number of respondents who agreed/strongly agreed that user acceptance was important to them. This findings support the literature review that user acceptance is critical to successful EMR access systems.

Hypothesis 2:

Extra-organisational variables will influence user acceptance. All these hypotheses received support by the rejection of the null hypothesis that the various extra-organisational variables would have no influence on user acceptance.

Hypothesis 2a: External training will have an positive influence on user acceptance.

The provision of external training had less of an influence on user acceptance than the provision of internal training by the respondents' respective organisations - non-primary health care organisation members would be more likely to use an EMR if training is provided by the secondary health care institution, whereas members of the primary health care organisation would prefer training provided by their primary health care organisation. This finding was supported by the ranking of respondents' preferences for the source of training - where external training by vendors has a lower preference to internal training provided by the primary or secondary health care organisation/institution to their respective members.

Interestingly, external training was preferred to internal training provided by the primary or secondary health care organisation/institution to respective non-members.

Hypothesis 2b: External support will have a positive influence on user acceptance.

The findings for this hypothesis were similar to that for external training.

Hypothesis 3:

Individual intra-organisational variables will have an influence on user acceptance. All these hypotheses received support by the rejection of the null hypothesis that

the various intra-organisational variables would have no influence on user acceptance.

Hypothesis 3a: computer experience will have a positive influence on user acceptance.

There was no statistically significant correlation between self-reported computer experience and user acceptance, perceived ease of use or perceived usefulness or wanting to be consulted about using an EMR. However, by using the t-test and ANOVA, it was possible to reject the null hypothesis that previous computer experience would have no effect on user acceptance. Whilst this does not necessarily prove true the hypothesis that previous computer experience influences user acceptance (Kuzma 1984), it enables the hypothesis to be retained by the research project.

Another reason for not rejecting this hypothesis is that the lack of statistically significant correlations between self-reported computer experience and user acceptance, perceived ease of use or perceived usefulness findings disagrees with much of the literature review. It may be that as the target population for the research project was less than 1% of the total health professionals in New Zealand a larger survey may result in different findings.

Hypothesis 3b: user participation will have a positive influence on user acceptance. The findings of the research project suggest that it is not just any user participation that influences user acceptance, it must be the 'right' user. Each group of health professionals had a higher level of user acceptance with representation from their own group rather than from any other group, although the number of specialists was too small to be representative. Thus, it is not enough to include a generic health professional as a user participant, but each sub-group within the potential health professional users must have the option of being represented by a someone of their choice.

Hypothesis 3c: personal approach by respected members of the profession will have a positive influence on user acceptance.

Again, this hypothesis received support by the rejection of the null hypothesis that a personal approach would have no influence on user acceptance. However, it did not score as high as some of the other variables influencing user acceptance - it ranked eighth in the average mean score of the respondents after data variables, personal cost, patient consent and realistic management expectations and relationships. Exactly who is considered by the respondents to be a respected member of the profession was not ascertained by this research project and will have to be determined.

Hypothesis 4:

Data variables will have a positive influence on user acceptance.

Hypothesis 4a: Record accuracy, integrity, and legitimacy will have a positive influence on user acceptance.

Hypothesis 4b: Privacy, security, and confidentiality will have a positive influence on user acceptance.

Hypothesis 4c: Patient consent will have a positive influence on user acceptance.

Hypothesis 4d: Ownership will have a positive influence on user acceptance.

All these hypotheses received support by the rejection of the null hypothesis that the various data variables would have no influence on user acceptance.

In fact, all the data variables and patient consent were ranked highest by the respondents as the variables that would most influence their agreeing to use an EMR.

Hypothesis 5:

Individual/professional/technical variables will have a positive influence on perceived usefulness.

Hypothesis 5a: Individual variables of goals/needs targeted, protect against litigation, decrease workload/pressure, and accountability will have a positive influence on perceived usefulness.

Hypothesis 5b: Professional variables of improved quality of care, and improved seamlessness of care will have a positive influence on perceived usefulness.

Hypothesis 5c: technical variables of improves communication and information sharing will have a positive influence on perceived usefulness.

Again, all these hypotheses received support by the rejection of the null hypothesis that the various individual/professional/technical variables will have a positive influence on perceived usefulness. All these variables were considered to strongly influence perceived usefulness as all the mean scores were greater than 4.0, with greater than 80% of the respondents agreeing or strongly agreeing that these variables would make it more likely that they would use an EMR.

Hypothesis 6:

Intra-organisational variables will have an influence on user acceptance.

Hypothesis 6a: Realistic expectations/relationships will have a positive influence on user acceptance.

Hypothesis 6b: Internal support and training have a positive influence on user acceptance.

Hypothesis 6c: Management support has a positive influence on user acceptance. Support for these hypotheses is again from the rejection of the null hypotheses that they have no influence on user acceptance. The findings for internal support and training have been discussed under the hypothesis relating to external support and training - members of each organisation would prefer support and training to be provided by their respective organisations.

Hypothesis 7:

Technical variables have a positive influence on perceived ease of use.

Hypothesis 7a: System user-friendliness has a positive influence on perceived ease of use.

Hypothesis 7b: Easy to learn has a positive influence on perceived ease of use.

Hypothesis 7c: Access and availability have a positive influence on perceived ease of use and hence with user acceptance.

The findings of this research project support these hypotheses and respondents scored these variables very highly - all means were greater than 4.6.

Hypothesis 8:

Perceived personal cost has a negative influence on user acceptance.

This hypothesis ranked fourth in the mean scores for the variables proposed to influence user acceptance and the null hypotheses that perceived personal cost had no influence or had a positive influence on user acceptance were rejected at a very significant level. The influence of perceived personal cost also outweighed any perceived benefits that the EMR might have for the respondents.

Hypothesis 9: This hypothesis was added from chapter 5 after the pilot study.

GPs and midwives do not differ in their requirements for successful EMR access systems.

There were a few areas where there was a statistical difference in the responses by doctors and by midwives.

- There was a significant difference between self-reported computer experience and occupation, (doctor mean = 3.08, midwife mean = 2.53, $p=0.007$) but the strength of the association was only slight (correlation coefficient $r = -0.2984$).
- There was a substantial correlation between personal computer use and self-reported computer experience. For GPs, the correlation was $r=-0.54$ for personal use at work and $r=-0.32$ for personal use at home. For midwives, the correlations were reversed, being stronger for personal computer use at home ($r=-0.65$) than at work ($r=-0.42$).
- There was a significant difference in the number of doctor and midwife practices that were computerised (92% versus 33%).
- Slightly more doctors considered user acceptance more important than did midwives but the difference was only significant at the 0.05 level.
- More doctors ranked ‘benefits exceeding costs’ as more important to them than ‘ease of use’ whereas midwives ranked ‘ease of use’ higher.
- Fewer doctors would use an EMR regardless of costs than would midwives.
- Fewer doctors would use an EMR regardless of any benefits than would midwives.

- More midwives felt that the data within an EMR should be used for medico-legal purposes
- More doctors than midwives felt that there should be different levels of access to the EMR for different groups of people and that certain data should be hidden from general access.

Of note, there was no difference between doctors and midwives regarding the importance of perceived usefulness, ease of use or user consultation. There was also no difference in the answers for the variables relating to user acceptance except as discussed in user participation - that midwives would prefer a midwife representative and GPs a GP representative. The number of specialists was too small to assess their preferences. Similarly, there was no difference in the answers for the variables relating to perceived usefulness or perceived ease of use. Both groups considered that access to and use of an EMR would increase their workload, that cost was a major issue, and that issues relating to data privacy, security, integrity, access, potential uses of the data, and patient consent were of major importance. Respondents in both groups felt that EMRs were an unwelcome challenge. However, respondents in both groups had positive comments to make about EMRs and there was no clear cut distinguishing features between those respondents who welcomed an EMR and those who did not.

7.2 Support for the theoretical model

Thus, whilst there are some differences between the two groups - doctors and midwives, the responses by both groups, separately and combined, support each of the hypotheses 1-8 above. Thus, the study findings provided considerable support for the proposed theoretical model as shown in Chapter Four, figure 2. Further work needs to be done with the model to determine the strength of support for each variable and linkage, and to determine the extent of any change in the support strengths by different health professional groups.

Summary of Chapter Seven

In summary, this chapter has discussed the support for each of the proposed hypotheses from chapter four from the findings from the primary health care survey, and has demonstrated the support for the proposed theoretical model. The next chapter will discuss results of the primary health care survey further and will consider the implications of these findings for the implementation of an EMR at a secondary health care institution that may be accessed by primary healthcare professionals.

Chapter Eight - Discussion

This chapter discusses the results of the primary care survey and considers the implications of the findings for the implementation of an EMR at a secondary healthcare institution that may be accessed by primary healthcare professionals.

8.1 Primary health care survey

8.1.1 Generalisability

Analysis of the demographics of the respondents showed that the GP respondents were more likely to be female, have a later year of graduation, be a member of the RNZCGP, to work in large group practices, to work in computerised practices and to use computerised clinical notes. There was no difference in membership status to the Indicative General Practitioners' register, the type of RNZCGP membership or in the type of tasks computerised.

98% of the respondents were members of the RNZCGP compared with 85% of the New Zealand GP workforce (RNZCGP 1996b) and this survey covered 8% of the total number of GP members of RNZCGP Wellington faculty and 2% of the total RNZCGP GP membership (RNZCGP 1995b). The Wellington faculty is the second largest in New Zealand and includes the sub-faculties of Nelson, Manawatu, Taranaki, Wanganui, Wairoa, and Hawkes Bay (RNZCGP 1995b)

Compared with GPs, midwives had an earlier year of nursing graduation, were mainly female, were more likely to work in solo practices or in small practices of 2 or 3 midwives, were more likely to have had computer training but less likely to work in computerised practices. They had a slight decreased use of computerised clinical notes.

The response rate of 61% is higher than a comparable study on the attitudes and reported behaviour towards GP computerisation (Thakurdas et al 1996 - 54% response rate) and the RNZCGP database survey (RNZCGP database 1995; Kljakovic 1996 - 55% response rate) and reflects the increasing difficulty of obtaining high response rates to surveys in general practice (McAvoy and Kaner 1996). The restriction of the survey population to primary health care professionals involved in obstetric practice and the response rate limits the generalisability of the survey results to the wider primary health care professionals however, the results do have important implications for secondary health care institutions.

8.1.2 Reliability and validity

As discussed previously, in chapter five, the reliability and validity of survey results are increased by using existing survey instruments with proven validity and reliability. Whilst much of the questionnaire used by this research project is new, it is based on existing survey instruments and piloted on various groups, thus has been validated. The validity and reliability of the questionnaire results need to be increased by re-running the survey and comparing the results (Zmud and Boynton 1991).

8.2 Implications for secondary health care institutions

This section presents the implications for all EMR users and proposes some recommendations for increasing the likelihood of successfully implementing an EMR access system between primary and secondary health care.

8.2.1 The need for computer training

The lack of computer experience and computer training amongst the respondents and the low level of computer confidence and high level of apprehensiveness regarding the use of an EMR indicates the need for computer training (GEHR 1993; Zinatelli 1994; Brown and Coney 1995). The majority of the primary health

care organisation members would prefer support and training to be provided by their organisation, whereas non-members would prefer the support and training to be provided by the secondary health care institution. This has implications for the source of computer training in that different sources will need to be offered to the potential users of the EMR and that the funding for this training will need to be considered. It is unlikely that the users will be happy to pay for their own training.

Some of the midwives and doctors who reported extensive experience with computers had more concerns than the other respondents, this may be because they have more experience on which to base their comments. Midwives rated their computer experience lower than the doctors. The lack of any correlation between self-reported computer experience and user acceptance, perceived ease of use or perceived usefulness or wanting to be consulted about using an EMR means that self-reported computer experience may not be an independent variable ultimately affecting EMR access success. However, previous computer experience cannot be dismissed from the model as it received considerable support as a variable that respondents felt would influence their acceptance of an EMR. Additional reasons for not discarding computer experience as an important variable is that the target population of the primary health care survey is less than 1% of the total number of health professionals working in New Zealand, thus a larger survey may demonstrate such correlations, and the literature support supports previous computer experience.

What the findings indicate is that a lack of previous computer experience is not a barrier to successful EMR access and use in itself, but may indicate that other variables such as support and training are more important to potential users with little or no previous computer experience.

8.2.2 Practice computerisation and cost

The personal cost of accessing the EMR is a major concern for all respondents and is a significant contributor to a user accepting to use an EMR. It is of even greater concern than any benefits of the EMR. Given the expressed requirements for extra

equipment such as laptops and modems to access the EMR remotely or when mobile, the cost of computerisation is likely to be a barrier to the adoption of the EMR and respondents have indicated that remote access is a requirement of the EMR, hence these personal costs to the users of accessing the EMR will need to be addressed. The fact that fewer midwife practices are computerised compared to doctor practice highlights the difference in computerisation between different primary health care groups and the large step that computerisation may be to many primary health care providers. Consideration may have to be given by secondary health care institutions towards providing increased motivational, financial, and training support to those primary health care professionals who are not computerised.

The slight correlation between practice size and computerisation is similar to findings by Walls (1989b) and Thakurdas et al (1996) although the association is not as strong as Walls found. This may be explained by an increasing number of small practices computerising since the time since Walls' study and the small number of solo practices in this study.

The lack of any correlation between practice computerisation and RNZCGP or Indicative General Practitioners register membership contrasts with Thakurdas et al (1996) who found that RNZCGP membership status was predictive of task computerisation. The fact that 98% of respondents were members of the RNZCGP may be responsible for the lack of any correlation between membership and computerisation.

Care must be taken in interpreting any relationship between practice computerisation and the use of an EMR. Whilst the majority of doctor practices were computerised, not every doctor personally used the computer, not all practices are computerised to the same extent and a significant number of practices do not use clinical notes. The five most common tasks computerised are recalls, age-sex register, appointments, financial, and letter writing. This agrees with Walls (1989b), Gribben et al (1995); Kljakovic (1996), Thakurdas et al (1996), and the RNZCGP databases (1995 and 1996).

8.2.3 User acceptance, patient consent, incomplete data

User acceptance is a significant variable for many respondents and, therefore, mandatory use of the EMR is unlikely to be successful, especially in the absence of any demonstrable benefits. Thus, secondary health care institutions will have to ‘sell’ the EMR to the primary health care providers to encourage them to participate fully with the EMR. The results also highlight the importance of representation from each group within primary health care, and that each group within primary care may have different needs and concerns regarding the EMR. The needs and concerns of the patient group is an area that needs to be urgently explored as patient consent is a major independent variable influencing user acceptance. Without patient consent, the EMR will not be used to its potential.

The major concerns that influence user acceptance of the EMR relate to data variables. If the data contained within the EMR is not secure and confidential, accurate and factual but also easily and quickly retrievable, the EMR is unlikely to be successfully used. The levels and types of access that different people have to the data within the EMR, and the uses to which that data will be put are also areas that influence user acceptance. The degree of concern that respondents have for these areas is highlighted in their comments that they would not transfer highly personal and sensitive information to the EMR without these areas having been clarified and proven secure and confidential and that even then, the only information that would be transferred to the EMR from primary care would be that which has patient consent. This has major implications for secondary health care institutions in that it is unlikely that the information within an EMR will ever be complete. This will need to be remembered when using the data within the EMR as it is very easy to assume that because the data is in computer form it is accurate, up-to-date and complete (Kroenke and Hatch 1993)

8.2.4 Perceived usefulness and ease of use

It is important that secondary health care institutions can demonstrate that the EMR has benefits for the user and/or patient. As the majority of respondents rated demonstrable benefits as a requirement in their decision to use the EMR, failure to do so will markedly reduce the use of the EMR. The top five most important features of an EMR that would make the respondents more likely to use the EMR are that it decreased the workload/pressure; meets goals/needs of the respondent, patients, practice, and population; enabled the respondent to work quicker; made the job easier and assists in improving quality of patient care. However, all the proposed independent variables rated above 3 (uncertain) and hence need to be considered in ‘selling’ the EMR to the primary health care professionals.

All the features addressed in the perceived ease of use section scored very highly and would similarly, have to be met in order to increase the likelihood of successful use of the EMR by primary health care users.

8.2.5 Support

The majority of the primary health care organisation members would prefer support and training to be provided by that primary health care organisation, whereas non-members would prefer the support and training to be provided by the secondary health care institution. Similar to the provision of training, therefore, multiple sources of support need to be available. The funding for and available of such support needs to be addressed by negotiation between the end-users and the secondary health care institution.

8.2.6 EMR uses

As discussed in user acceptance above, there is a high level of concern regarding the uses to which the data held within an EMR will be put. Clinical patient care was the only use for which there was no disagreement. The lack of agreement regarding administration and financial uses of data contained within an EMR is of concern as this may limit the data that is transferred to the EMR. This area needs

to be clarified by secondary health care institutions and demonstrated to the primary health care professionals exactly what data will be used for what purpose and by whom. There were comments added in this section that amended the level of disagreement if there was sufficient security and preservation of patient confidentiality. Comments suggested that there could be different levels of access for non-clinical patient care uses. The level and type of access to the data within the EMR was addressed in the next section.

8.2.7 EMR access

The results from the section on EMR access demonstrate a major area of concern regarding the use of EMRs. Whilst the majority of respondents agreed that certain data should be ‘hidden’ from general access, that there needs to be different levels of access for different groups of people such as health professionals, administrative staff, etc, the types and levels of access need to be identified. There is disagreement regarding the restrictions that should be placed on different groups of potential users of the data. This is an area that needs to be clarified before the EMR is implemented.

8.2.8 Meaning of an EMR

The wide range of answers regarding the perceived effects of using an EMR indicate the range of feeling amongst primary health care providers. They are not a uniform group and must therefore be treated as individuals with different concerns and needs. Thus, the level and type of training and support provided must to be flexible to accommodate these differences. The amount of financial assistance required will vary depending on the existing level of computerisation, the ability and willingness to fund the changes required to access the EMR, the degree and type of remote access permitted, and the amount of funding provided by sources other than the secondary health care institution, such as IPAs, Ministry of Health, etc. The degree of ‘selling’ the EMR will vary as some respondents will embrace it readily and others will be very resistant to its implementation, and the facility for

primary health care providers to opt out of using the EMR altogether needs to be considered.

In summary, whilst acknowledging the limited generalisability of the primary health care survey results and the difficulties with demonstrating extensive validation and reliability, the results of this research project have certain important implications for the successful implementation by secondary health care institutions of an EMR access system for primary health care professionals. The next chapter summarises the conclusions and recommendations from this research project.

Chapter Nine - Conclusions and Recommendations

9.1 Conclusions

These conclusions are based on the findings from the literature review and on the findings from the primary health care survey.

1. Most GP practices are computerised to some extent but only a minority would use electronic medical records within their primary care practice. The majority would use manual (paper) records or a combination of electronic and manual records. There are many different electronic medical records (EMRs) in use in primary care.
2. Compared to doctors, midwives have a much lower level of practice computerisation. There is a wide range of computer experience amongst doctors and midwives and most are both keen and apprehensive about using an EMR. Some doctors and midwives are very worried about the use of EMRs.
3. The gravest of concerns about EMRs relate to data management - that the data is easily and quickly retrievable, is accurate and factual, and is secure and confidential. Additional concerns regarding EMR access relate to perceived personal cost and patient consent. The personal costs of using an EMR are of even greater concern than benefits to the respondents.
4. Perceived as easy to use, perceived as having benefits to the patient or the health professional, and that the health professional, or their representative, had been consulted about using the EMR are major variables affecting EMR use.
5. User acceptance is a major variable affecting EMR use and mandatory use is unlikely to be successful.
6. Demonstrable benefits for the users and for their patients are more important for the users than demonstrable benefits for the organisation. Important benefits of

an EMR are that it decreased workload/pressure; meets goals/needs of the user, patients, practice, population; enabled the user to work quicker; made the user's job easier; and assists in improving quality of patient care.

7. Data contained within an EMR will be incomplete, especially with regard to personal or 'sensitive' information such as mental health, sexual health, some obstetric details and certain social information.
8. Modem access to the EMR as well as direct physical access to terminals within secondary care is required.
9. Access to, and uses of, the data contained within an EMR is of concern.
Respondents felt that access should be restricted, that there should be different levels of access for different groups of people such as health professionals, administrative staff, etc, and that certain information should be kept 'hidden' from general access.
10. The use of existing medical record based information systems by primary health care users in secondary health care institutions in New Zealand involves a lot of work, is time consuming, is not user-friendly and has no demonstrable benefits. The implementation process was felt to be difficult, that training and support are lacking. Terminals availability is a problem and there was no accountability for data entry. Unless the EMR access system is easier to use and provides clear benefits for maternity care, it is unlikely to have appeal to midwives.
11. The major problems for secondary care with the current primary health care users access to existing medical record based information systems is that the data provided is often incomplete, inaccurate and not up-to-date. The major problems with secondary care information systems is that there are a variety of systems with little standardisation and data retrieval is often difficult and time-consuming. Security and privacy are also concerns for secondary care. Also secondary care data requirements are governed by the contractual and

government legislative requirements for health data collection and management.

12. World-wide concerns about EMRs relate to the multiplicity of different EMR systems in existence and in development. The lack of data, coding classification, and communications standards results in major problems and concerns about cross-systems information transfer.

This research project has made a number of recommendations based on the limitations of the research project as discussed in Chapter Two, the restrictions on the research design as discussed in Chapter Five, the results of the primary health care survey presented in Chapter Six and the implications discussed in Chapter Eight. These recommendations are summarised as follows.

9.2 Recommendations

1. that a detailed implementation plan is followed that incorporates the results and concerns of both the primary care users and the secondary care users, especially with regard to:
 - representatives of the different primary care health professional groups are actively involved in the implementation of the EMR
 - the existing problems with current information systems are not replicated
 - access is improved and that modem access be available
 - the concerns about security, privacy, and confidentiality are addressed and resolved
 - the types and levels of access permitted are defined
 - the uses of the information are defined
 - costs are addressed and demonstrable benefits are identified
 - patient consent is sought for all data entered into the EMR
 - training and support provision is flexible and responsive to individual user needs

2. that active steps be taken to encourage, support and promote the EMR and EMR usage, but that EMR usage is not mandatory
3. that data, communication and coding classification standards are met where they exist, and developed where they are absent, so as to enable New Zealand to avoid the problems the rest of the world are having with cross-systems information incompatibility
4. that further research is conducted into patient's concerns about EMR usage

9.3 Thesis Summary

This research project investigated the development of a theoretical model for the determination of the critical success factors for an electronic medical record access system held by secondary health care institutions but accessed by non-employee primary health care professionals. Several areas for further research have been identified. This research project has demonstrated considerable support for the proposed model as shown in Chapter Four and has added to the published literature regarding health care professionals and their use of EMRs. Some major areas of concern for health care professionals regarding the implementation of EMRs have been highlighted and recommendations for increasing the likelihood of the successful implementation of EMR access systems have been made. It is hoped that the findings and recommendations of this research project will stimulate further research in this area, encourage the development of New Zealand national standards for the development of EMRs and increase the co-operation, liaison between, and participation by the many potential users, including patients, in the development of an EMR access system.

Glossary

ACC - the Accident rehabilitation and Compensation Insurance Corporation

CHE - Crown Health Enterprise - the large publicly owned health care providers which are based around one or more public hospitals, there are 23 in New Zealand (Minister of Health 1996)

CSF - critical success factor

DSW - Department of Social Welfare

EMR - electronic medical record

EUC - end-user computing

GP - general practitioner - is an appropriately qualified medical graduate who has particular knowledge and skills to provide personal, whanau and community-orientated comprehensive primary medical care that continues over time, is anticipatory as well as responsive, and is not limited by age, sex, race, religion or social circumstances of patients, nor by their physical or mental states, and who is registered by the New Zealand Medical Council and is a holder of a current annual practising certificate issued by that Council (CRHA 1996b; Richards 1997)

Health care institute - a location for the provision of health or disability care. A secondary care institution provides health or disability care at the level of secondary care, whereas a tertiary health care institute will provide such care to the level of tertiary care. Hospitals are examples of secondary or tertiary health care institutes.

Health Professional - occupational groups which provide clinical and other specialised services in the management of patients (McAvoy, Davis, Raymont, and Gribben 1994)

IPA - Independent Practitioner Association - group of practitioners (mostly GPs) which is formed to provide its members with common services (Minister of Health 1996)

IS - information system - a system of functions concerning the acquisition and transfer of information to a user or group of users (Minister of Health 1996)

IT - information technology - technology dealing with information processing, storage, and transmission (Minister of Health 1996)

LMC - lead maternity carer as defined by section 51 of the Health and Disability Act 1993 concerning the Provision of Maternity Services 1996. May be a GP, midwife, or obstetric specialist selected by the woman with responsibility for assessment of her needs, planning her care with her and the care of her baby and being responsible for ensuring provision of maternity services will be the cornerstone of future maternity care in New Zealand (CRHA 1996b)

Midwife - a registered midwife whose name is included in the register of midwives maintained by the Nursing Council of New Zealand in accordance with the Nurses Amendment Act 1990 and who is the holder of a current annual practising certificate issued by that Council (CRHA 1996b)

NHS - National Health Service

NZGPA - New Zealand General Practitioners' Association

NZHIS - New Zealand Health Information Service

NZMA - New Zealand Medical Association

Obstetric specialist - a medical practitioner possessing Specialist status as a Obstetrician by the New Zealand Medical Council and is the holder of a current annual practising certificate issued by that Council (CRHA 1996b)

Obstetrics - the medical speciality of pregnancy/maternity care - providing comprehensive pregnancy and childbirth and parenting services for women, their babies, and their families or whanau (Central Regional Health Authority 1995; CRHA 1996b)

Primary care - health or disability care provided in the community, usually by direct access and for common problems. It is usually the first point of contact with the health system (Central Regional Health Authority 1996a).

RHA - Regional Health Authority - there were four RHAs established in 1993 which were funded by the New Zealand Government on a population-based formula with the role of purchasing publicly-funded core health and disability support services on behalf of their population. Replaced by the Transitional Health Authority in 1997 (Central Regional Health Authority 1996b, Minister of Health 1996).

RNZCGP - Royal New Zealand College of General Practitioners

Secondary care - health or disability care dealing mostly with less common problems, usually by referral from the primary care sector, and providing more specialised care with access to a greater level of diagnostic skills (Central Regional Health Authority 1996a).

Section 51: section 51 of the Health and Disability Act 1993 concerning the Provision of Maternity Services 1996

TAM - Technology Acceptance Model

TRA - Theory of Reasoned Action

Tertiary care - health or disability care which may be provided at the same site as secondary care, and provides even more specialised care with access to a greater level of diagnostic skills.

Appendix One: Literature review journal list

The list of journals/newspapers referenced in the literature review.

British Journal of General Practice

British Journal of Hospital Medicine

British Medical Journal (BMJ)

Computer Personnel

European Journal of Information Systems

Evidence-Based Medicine

Information Systems Research

Journal of Management Information Systems

Journal of Systems Management

Journal of the American Medical Informatics Association (JAMIA)

Journal of the Medical Defence Union

Lancet

Management Science

Medical Council of New Zealand (NZMC) newsletters

Medical Journal of Australia (Med J Aust)

MIS Quarterly

New Ethicals

New Zealand Doctor

New Zealand Family Physician (NZ Family Physician)

New Zealand General Practitioners' Association (NZGPA) newsletters

New Zealand Health and Hospital (NZH&H)

New Zealand Health Information Service (NZHIS)

New Zealand Medical Association (NZMA) newsletters

New Zealand Medical Journal (NZ Med J)

Patient Management

Royal New Zealand College of General Practitioners (RNZCGP) publications

Appendix Two: Definition of Variables

Extra-organisational variables

External support

Defined as the technical support provided by friends, consultants, vendors, or other external sources, ie.: individuals or groups with computer knowledge who are external to the secondary health care institution and the primary health care organisation. It is proposed that it will relate to user acceptance and is measured by a 5-point Likert scale, ranging from 1=strongly disagree to 5=strongly agree.

External training

Defined as the amount of training provided by friends, consultants, vendors, or other external sources, ie.: individuals or groups with computer knowledge who are external to the secondary health care institution and the primary health care organisation on the use of hardware, software, data management and procedures. It does not include self-training. It is proposed that it will relate to user acceptance and is measured by a 5-point Likert scale, ranging from 1=strongly disagree to 5=strongly agree.

Intra-organisational variables

Individual

Computer experience

Defined as the skill-level that the respondent feels that they possess (Nelson and Cheney 1987). Measured as the current level of skill that the respondent feels they already possess from 1 (none) to 5 (a great extent) on a Likert scale. Also asked if used a computer at work, and at home.

Goals/needs targeted

Defined as the identified needs and goals of the respondent for themselves and/or their practice. Respondents were not asked what their goals/needs were in this project. It is used as a variable that relates to perceived usefulness of the system

and is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Decrease workload/pressure

Defined as the professional workload and pressure, including administrative, experienced by the respondent in running their practice. How respondents would like the information system to reduce the workload is not measured, only that a reduction in workload/pressure will correlate to perceived usefulness as measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Protect against litigation

Defined as protection against professional litigation. How an information system will protect against litigation will not be measured, only the belief held by respondents that it is a variable affecting perceived usefulness as measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Accountability

Defined as being identifiable and held accountable for one's actions. Again, this variable will not be measured, only the belief held by respondents that accountability is a variable affecting perceived usefulness as measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Perceived personal cost

Defined as any perceived costs to the respondent, such as financial costs or increased demands on their time. It is measured in the 7-item scale used to investigate the conditions of user acceptance. Each item was measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

User participation

User participation can range from no involvement to in-depth involvement with responsibilities and control and from direct to indirect control (Ives and Olson 1984; Barki and Hartwick 1994).

User participation is defined as whether the user, or their representative, is involved in the development and/or implementation of the information system (Barki and Hartwick 1994). The type and degree of user participation is not considered in this research project. Actual user participation is not measured. The belief held by respondents that user participation is a variable affecting their willingness to use an EMR (user acceptance) is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Personal approach

Defined as a personal approach by a respected member of the profession to the respondent asking for their participation in the use if the information system. The belief held by respondents that a personal approach is a variable affecting their willingness to use an EMR (user acceptance) is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Professional

Improve quality of care

Defined as a perceived improvement in quality of care. The definition of quality of care and what constitutes good quality of care are not considered in this project. The fact that the respondent considers that the system will improve or not improve quality of care is what is considered in this project and is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Improve seamlessness of care

Defined as a perceived improvement in seamless of care. The definition of seamlessness of care and what constitutes seamlessness of care are not considered in this project. The fact that the respondent considers that the system will improve or not improve seamlessness of care is what is considered in this project and is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Technical

Easy to learn

Defined as the ease of learning to use the EMR/information system. The belief held by respondents that easy to learn is a variable affecting perceived ease of use is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

EUC tools user-friendliness

Defined as how user-friendly the respondent considers that the information system should be. Does not consider what factors make an information system user-friendly, just whether it is important for the respondents that a system is or is not user-friendly. The belief held by respondents that user friendliness is a variable affecting perceived ease of use is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Access/availability

Defined as the amount of time that the computer system is available to the respondent and the amount of time that the respondent can physically access the system (Pomare 1992). The belief held by respondents that access/availability is a variable affecting perceived ease of use is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Improves communication and information sharing

Defined as communication and the sharing of information between primary and secondary care. The specific pieces of information that are transferred are not considered in the model, only the broad concept of improving communications and information sharing. The belief held by respondents that improving communication and information sharing is a variable affecting perceived usefulness is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Organisational

Top management support

Defined as the level of support provided by the top managers of the secondary health care institution. The belief held by respondents that top management support is a variable affecting user acceptance is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Internal EUC support

Defined as the technical support provided by the secondary health care institution or by the primary health care organisation. It is proposed that it will relate to user acceptance and is measured by a 5-point Likert scale, ranging from 1=strongly disagree to 5=strongly agree.

Internal training

Defined as the amount of training that should be provided by the secondary health care institution or by the primary health care organisation. It does not include self-training. It is proposed that it will relate to user acceptance and is measured by a 5-point Likert scale, ranging from 1=strongly disagree to 5=strongly agree.

External and internal support and training are also measured by a ranking scale where the respondents are asked to rank, in order of preference, their choices for the provision of such support and training. This set of questions was specifically asked for by the primary health care organisation in order to identify who should provide the support and training.

Realistic expectations/relationships

Defined as the relationship between the GP end-user and the secondary health care organisation. What is considered realistic is left for negotiation between the parties who will use the information system. The belief held by respondents that realistic expectations/relationships is a variable affecting user acceptance is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Data

Secure and confidential

Relates to the data contained in the EMR. The belief held by respondents that secure and confidential data is a variable affecting user acceptance is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Accurate/factual/easily retrievable

Relates to the data contained in the EMR. The beliefs held by respondents that secure and confidential data and easily and quickly retrievable data are variables affecting user acceptance are measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Patient consent

The specific consent by the patient for the data relating to that patient to be used in an EMR. The factors that a patient considers important before giving their consent are not considered in this research project. It is whether the existence of patient consent is a requirement for GPs in agreeing to use an EMR that is of concern. The belief held by respondents that patient consent is a variable affecting user acceptance is measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Perceived Ease of Use

Defined as the degree to which the respondent believes that using the computer system will not require a great deal of effort (Zinatelli 1994). The measurement scales have been adapted from Davis' original TAM (Davis 1989; Davis et al 1989; Moore and Benbasat 1991; Adams et al 1992) to take into account the fact that the system is a new concept and is not in existence yet.

The measurement scale consists of 4 items in common with both Davis (1989), Davis et al (1989); Moore and Benbasat (1991) and Adams et al (1992): easy to learn, clear and understandable, and easy to become skilful. Easy to use was measured in a separate section. Three additional items were added from the literature review - accessible whenever wanted , user-friendly interface and easy to remember how to use.

Each item was measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

Perceived Usefulness

Defined as the extent to which the respondent believes that using the computer system would improve his/her performance (Zinatelli 1994). The measurement scales have been adapted from Davis' original TAM (Davis 1989; Davis et al 1989; Moore and Benbasat 1991; Adams et al 1992) to take into account the fact that the system is a new concept and is not in existence yet.

The relationship between perceived usefulness was first measured by two items measuring beliefs: that it would improve work performance, and that it offered advantages for work. These were then asked in more detail with a measurement scale consisting of 11 items. 2 items are in common with Davis (1989), Davis et al (1989) and Adams et al (1992) - work more quickly, and make job easier. The item scale of job performance used by Davis (1989), Davis et al (1989) and Adams et al (1992) was divided into 3 item scales, the aims of the health reforms: that of improving quality of care, improving seamlessness of care, and improved communication and information sharing. The item scale of useful in Davis (1989), Davis et al (1989) and Adams et al (1992) was divided into the proposed benefits of an EMR as identified in the literature review: meets the goals/needs of yourself, your patients, practice, population; decrease the workload and/or pressure; protect against litigation. Similarly, the item scale of increased productivity was broken into: accessing from different computer systems; flexible to different individual styles. The item scale of holding accountable any one who makes changes to the system was added as the literature review indicated that an EMR system would not be considered useful if this was not part of the system.

Each item was measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

User acceptance

Defined as the degree of willingness of an individual or group to utilise the information system (Nelson and Cheney 1987). Nelson and Cheney (1987) discuss

how user acceptance is a subjective factor and not easily measured. They argue for the use of surrogate measures of system use and satisfaction. This project uses a measure of the importance of user acceptance by asking respondents to state to what degree they agree that it is important for them to be willing to use the system rather than be told to use the system as part of a contract.

Existing measurement scales for user acceptance were not found in the literature review, therefore they were constructed from scratch but based on the scales used by perceived ease of use and perceived usefulness. The measurement scale for user acceptance consisted of two items: it is important that I have a choice about using an EMR; and I would be more likely to use an EMR if I agreed to use it. The variables proposed to relate to user acceptance are measured on a 14-item scale. Each item was measured by a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

The conditions under which the respondents would be prepared to use an EMR were measured by an 7-item scale. These items addressed the issues of EMR benefits and costs.

The relationship between perceived ease of use, perceived usefulness and user acceptance was also assessed by a ranking scale in which respondents were asked to rank, in order of importance for them, the role of these three variables in their decision to use the EMR system. The rankings were then used to support or refute the proposed theoretical model.

EUC Success

The success of the EMR access system is not measured in this research project as it is not implemented yet. The purpose of the research model is to use a theoretical model and a literature review to identify the CSFs that would result in EUC success. It will address the variables that are considered to impact on the GPs' perceived satisfaction of the system when it is implemented. These are user acceptance, perceived ease-of-use, and perceived usefulness.

System Usage

There are many indicators of computer usage (Igbaria 1990, cited in Pomare 1992; Kivijardi and Zmud 1993; Zinatelli 1994). The most commonly used indicators are perceived daily use (hours per day) and perceived frequency of use (Zinatelli 1994). The daily use and frequency if use for GPs accessing the EMR will depend, to a large extent, on the nature of their work. A GP, who is an LMC, with a busy obstetric load, will have to access the computer system much more often than a GP/LMC with a small obstetric load. Hence, these are not good indicators for this study. Also as the system is not in place yet, it is not possible to assess current system usage.

System Utilisation

This is defined as the extent to which the computer system is used, the number of software packages used, or the number of different tasks for which the system is used (Gogan 1984; Cheney et al 1986; Davis et al 1989; Thompson et al 1991; Zinatelli 1994).

The extent of computer usage by GPs will be defined by the protocols determined by the end-users and the secondary health care institution and thus will be beyond individual determination. Thus, system utilisation is not a good indicator of EUC success for this study.

EUC satisfaction

This is defined as the attitude of the respondent towards the system (Rivard and Huff 1988, cited in Pomare 1992; Zinatelli 1994).

Although this is a common surrogate for system success with existing measurement instruments (Yoon et al 1995), it will not be measured in the project. As the computer system is not implemented yet, it is not possible to assess the attitudes of the GPs to the actual working of the EMR system. Thus, this research project cannot measure actual EUC satisfaction.

The questionnaire addressed other issues relating to EMR usage. It addressed the issues of:

- the uses to which the data contained within an EMR should be put
- what obstetric information should not be stored in an EMR
- what actions a respondent would take if it was a requirement that all information transferred from primary to secondary care be entered in the EMR

The purpose of these questions was to add further to the body of literature regarding GP attitudes towards EMR usage and to address the issue of mandatory transfer of clinical data.

Two items were added to address the attitude towards using an EMR - apprehensive about using an EMR; and keen to use an EMR. These were included as the literature review suggested that computer anxiety is a barrier to successful computer use by GPs.

Two further items were added to assess attitudes to the idea of implementing an EMR access system, rather than the attitude to the EMR itself - that implementing an EMR was a useful thing to do, (changed after feedback to 'is worth investing time and effort') and that implementing an EMR would have too many problems to be successful.

Appendix Three: Primary health care survey questionnaire

Questionnaire for Electronic Medical Access

Please complete each item on this questionnaire by circling the appropriate answer or supplying the appropriate information and return the completed questionnaire in the enclosed stamped addressed envelope to

Section One: Demographics

Q.1 Please CIRCLE your age (in years).

25-30	31-35	36-40	41-45
46-50	51-55	56-60	61+

Q.2 Please circle: MALE FEMALE

Please circle: GP OBSTETRICIAN MIDWIFE

Q.3 Qualifications:

Year of medical/nursing graduation: _____

Please list all your medical/nursing qualifications:

Please list any non-medical/nursing qualifications that you may have:

Q.4 Year commenced in general practice/specialist obstetrics/midwifery -

Q.5 RNZCGP membership details (if you a specialist obstetrician or midwife, please go to Q.7)

Please circle to indicate your type of membership to the RNZCGP.

Fellow Member Associate Not a member

Q.6 Are you on the Indicative GP Register?

Yes

No

Don't know

This next part considers details of your practice (if you work in more than one practice, please answer for your main practice).

Q.7 Practice Type:

Please circle the description that best fits the location of your main practice.

Inner city

Suburban

Semi-rural

Rural

Isolated

Q.8 Practice Status:

Please circle the number of doctors in your practice:

0 1 2 3 4 5 6 7+

Please circle the number of midwives in your practice:

0 1 2 3 4 5 6 7+

Please circle your workload within that practice:

part-time (=/ $<7/10$ ths) full-time ($>7/10$ ths)

Q.9 If you are in a group practice, please indicate your position:

partner

assistant

associate

other (please specify)

Q.10 Computer training.

Have you had any formal computer training? Yes No

Q.11 If you have had some formal computer training, please indicate where?

Polytechnic	short courses
University	other (please state)

.....

Q.12 Practice computerisation.

Is your practice computerised?	No	- go to QUESTION 13
	Yes	- go to QUESTION 14

Q. 13 If your practice is not computerised, do you intend to computerise within the next 12 months? Yes No**Q.14** If your practice is computerised, please indicate what tasks are computerised regardless of who actually uses the computer. Please circle as many as needed:

appointments	recalls	e-mail
disease register	age-sex register	the Internet
laboratory results	prescriptions	other - please specify
clinical notes	letter writing/referrals
financial management	audit	

Q.15 Personal Computer Use. Do you PERSONALLY currently use a computer:

at work:	yes	no
at home:	yes	no

If you answered YES, please circle the activities for which that you PERSONALLY use a computer. Otherwise, go to the next question.

At work:	At home:
appointments	word processing (e.g. Word)
financial management	databases (e.g. Access)
recalls	financial management
age-sex register	spreadsheets (e.g. Excel)
disease register	desktop publishing (e.g. Publisher)
prescriptions	graphics
laboratory results	games
letter writing/referrals	programming (e.g. COBOL/C++)
clinical notes	e-mail
e-mail / the Internet	the Internet
audit	other - please specify
other - please specify
.....	

Q.16 Computer Experience:

How would you rate your current level of computer experience, as determined by how you feel you are able to handle such computer tasks as making appointments, writing referral letters, entering patient details and writing clinical notes?

1 = none	2 = to a little extent	3 = to some extent
4 = to a great extent	5 = to a very great extent	

Please circle one number only.

1 2 3 4 5

Section Two. Electronic medical records (EMRs).

This section asks questions on your opinions about the use of electronic medical records (EMRs).

Q.17 Computer Use

Please answer each statement as it relates to you personally.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

Circle ONE number only for each statement.

- | | | | | | |
|--|---|---|---|---|---|
| 1. It is important to me that I have a choice about using the EMR | 1 | 2 | 3 | 4 | 5 |
| 2. I would be more likely to use an EMR if I agreed to use it (rather than be told to use it) | 1 | 2 | 3 | 4 | 5 |
| 3. I would be more likely to use an EMR if it were easy to use | 1 | 2 | 3 | 4 | 5 |
| 4. I would be more likely to use an EMR that I thought would improve my work performance | 1 | 2 | 3 | 4 | 5 |
| 5. I would be more likely to use an EMR that offered advantages for my work | 1 | 2 | 3 | 4 | 5 |
| 6. I would be more likely to use an EMR that I, or a member of my profession, had been consulted about | 1 | 2 | 3 | 4 | 5 |

Q18. In making your decision whether to use an EMR, please **rank** the following variables according to how important they would be in your decision. Use each ranking number once only.

1= most important	2= less important	3= least important
-------------------	-------------------	--------------------

- I have a choice about using the EMR
 The EMR is easy to use
 The benefits exceed the costs for me/my patients

Q. 19 When would an EMR be used

This question investigates the conditions under which you would be willing to use an electronic medical record (EMR).

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

- | | | | | | | |
|----|---|---|---|---|---|---|
| 1. | I would use an EMR, regardless of any demonstrable benefits, because it was part of a work related contract | 1 | 2 | 3 | 4 | 5 |
| 2. | I would use an EMR, regardless of the costs to myself, because it was part of a work related contract | 1 | 2 | 3 | 4 | 5 |
| 3. | There would need to be demonstrable benefits before I would use an EMR | 1 | 2 | 3 | 4 | 5 |
| 4. | I would refuse to use an EMR if there were no demonstrable benefits, even if it were part of a contract | 1 | 2 | 3 | 4 | 5 |
| 5. | I would use an EMR with demonstrable benefits only for the organisation | 1 | 2 | 3 | 4 | 5 |
| 6. | I would use an EMR with demonstrable benefits for myself | 1 | 2 | 3 | 4 | 5 |
| 7. | I would use an EMR with demonstrable benefits for my patients | 1 | 2 | 3 | 4 | 5 |

Q.20 Electronic medical record (EMR) - user acceptance

The next question investigates what functions or activities related to an electronic medical record (EMR) that you consider would make you more likely or more WILLING TO USE the EMR.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

- | | | | | | |
|--|---|---|---|---|---|
| 1. the higher the level of personal computer experience prior to using the EMR, the more useful an EMR will be | 1 | 2 | 3 | 4 | 5 |
| 2. Having a GP representative participate in the development of the EMR will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 3. Having a midwife representative participate in the development of the EMR will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 4. Having a specialist obstetrician representative participate in the development of the EMR will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 5. a personal approach by a member of my profession explaining and supporting use of the EMR will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 6. that the data is secure and confidential in the EMR will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 7. that the data in EMR is accurate and factual will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 8. that the data in EMR is easily and quickly retrievable will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 9. I will be more likely to agree to use an EMR if there is patient consent (to put their information on the EMR) | 1 | 2 | 3 | 4 | 5 |
| 10. obvious ownership of the data in the EMR will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 11. being acceptable in court in the place of paper records will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 12. management having realistic expectations and realistic relationships with the EMR users will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 13. how likely I am to agree to use an EMR will depend on the level of management support (from Capital Coast Health) | 1 | 2 | 3 | 4 | 5 |
| 14. how likely I am to agree to use an EMR will depend on the perceived personal cost (both time and financial) of using the EMR | 1 | 2 | 3 | 4 | 5 |

The next section of user acceptance considers the areas of training and support. Training refers to learning how to use the computer and the EMR. Support refers to on-going assistance with using the EMR, such as help desks, someone to fix the computer if it stops working, etc. The purpose of this section is to ascertain if you have any preferences for the source of any training and support for the EMR.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

- | | | | | | |
|---|---|---|---|---|---|
| 15. the provision of support in using the EMR from the secondary health care institution will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 16. the provision of support in using the EMR from the primary health care organisation will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 17. the provision of support provided by anyone not related to the primary or secondary health care organisation/institution in using the computer and its software will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 18. training in how to use the EMR provided by the secondary health care institution will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 19. training in how to use the EMR provided by the primary health care organisation will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 20. training in how to use the EMR provided by anyone not related to the primary or secondary health care organisation/institution will make me more likely to agree to use an EMR | 1 | 2 | 3 | 4 | 5 |

Please rank, in order of preference, your preferred choices for the provision of EMR support in the left-hand column and for EMR training in the right-hand column.

1= most preferred	2= less preferred	3= least preferred
EMR support		EMR training
	Secondary health care institution	
	Primary health care organisation	
	External agencies/vendors/etc	

Please add any additional features of an EMR that would increase your likelihood to agree to use an EMR, with a score from 1-5.

	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

Q.21 Features of the electronic medical record (EMR) - usefulness

The next question investigates what potential functions or activities related to an electronic medical record (EMR) that you consider would be useful for your work. For example, if you consider that decreasing your workload would be a useful activity for the EMR, then circle 5. However, if you consider that decreasing your workload is not a useful activity or function of the EMR, then circle 1.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

- | | | | | | |
|---|---|---|---|---|---|
| 1. I would be more likely to use an EMR that enabled me to work more quickly | 1 | 2 | 3 | 4 | 5 |
| 2. I would be more likely to use an EMR that makes my job easier | 1 | 2 | 3 | 4 | 5 |
| 3. an EMR that meets the goals/needs of yourself, your patients, practice, population would be useful | 1 | 2 | 3 | 4 | 5 |
| 4. an EMR that decreases the workload and/or pressure on yourself and the practice would be useful | 1 | 2 | 3 | 4 | 5 |
| 5. an EMR that helps to protect you against medical litigation would be useful | 1 | 2 | 3 | 4 | 5 |
| 6. holding anyone who makes any changes to the EMR accountable for those changes will make an EMR more useful | 1 | 2 | 3 | 4 | 5 |
| 7. an EMR that assisted in improving communication and information sharing (between primary and secondary care) would be useful | 1 | 2 | 3 | 4 | 5 |
| 8. an EMR that can be accessed from different computer systems would be useful | 1 | 2 | 3 | 4 | 5 |
| 9. it would be useful if an EMR was flexible to different individual user styles | 1 | 2 | 3 | 4 | 5 |
| 10. it would be useful if an EMR would assist in improving quality of patient care | 1 | 2 | 3 | 4 | 5 |
| 11. it would be useful if an EMR would assist in improving seamlessness of care (between primary and secondary care) | 1 | 2 | 3 | 4 | 5 |

Please add any additional activities that you feel would be useful for an EMR to perform, with a score from 1-5.

	1	2	3	4	5
	1	2	3	4	5

Q.22 Features of the electronic medical record (EMR)

- ease of use

The next question investigates what features related to an electronic medical record (EMR) that you consider would make an EMR easier for you to use. For example, if you consider that an EMR which was easy to learn to use would make it easier for you to use, then circle 5. However, if you consider that ease of learning does not relate to how easy it would be for you to use the EMR, then circle 1.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

- | | | | | | |
|---|---|---|---|---|---|
| 1. an EMR that is easy to learn (for you) would be easier to use | 1 | 2 | 3 | 4 | 5 |
| 2. an EMR that has a user-friendly interface (Windows-type) would be easier to use | 1 | 2 | 3 | 4 | 5 |
| 3. to be able to access the EMR whenever one wants, not just at set times, would make the EMR easier to use | 1 | 2 | 3 | 4 | 5 |
| 4. an EMR that is clear and understandable would be easier to use | 1 | 2 | 3 | 4 | 5 |
| 5. an EMR that was easy to become skilful at using would be more likely to be used | 1 | 2 | 3 | 4 | 5 |
| 6. an EMR that was easy to remember how to use would be more likely to be used | 1 | 2 | 3 | 4 | 5 |

Please add any additional features that you feel would make it easier for you to use an EMR, with a score from 1-5.

	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

Q.23 Uses of an EMR

The information contained within an EMR may be used by many different groups of people. Please answer the following statements regarding your opinions about each potential use of the information.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

The information within an EMR should be 1 2 3 4 5
used for clinical patient care

The information within an EMR should be 1 2 3 4 5
used for administration, such as bed
occupancy figures, staffing levels.

The information within an EMR should be 1 2 3 4 5
used for financial considerations, such as
budgeting, contracting, managed care

The information within an EMR should be 1 2 3 4 5
used for medico-legal purposes

The information within an EMR should be 1 2 3 4 5
used for audits

The information within an EMR should be 1 2 3 4 5
used for research

The information within an EMR should be 1 2 3 4 5
used for clinical teaching

Q.24 Access to an EMR

The following question considers the level of access that, in your opinion, various groups of people should have to an EMR. Please answer 1 to 5 for each statement.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

There should be different levels of access for different groups of people, ie.: health professionals, administrative staff, etc

1 2 3 4 5

Certain information should be ‘hidden’ from general access, ie.: sensitive issues like HIV results, mental health records, etc

1 2 3 4 5

Anyone with a legitimate reason to access the EMR should be able to access any information they feel relevant for their reason

1 2 3 4 5

Only health professionals should have access to an EMR

1 2 3 4 5

Q.25 Obstetric information stored in an EMR

The PIMS database currently used in the maternity units of Capital Coast Health may be interfaced with the EMR. The following question considers what information you feel should be transferred to/from an organisation-wide EMR, and hence STORED IN THE EMR, for the practice of obstetrics.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

Clinically relevant obstetric information

1 2 3 4 5

Personal and social history, such as marital status, smoking, alcohol, drug usage, conditions at home

1 2 3 4 5

Past medical and surgical history

1 2 3 4 5

Mental health consultations

1 2 3 4 5

Sexual health consultations

1 2 3 4 5

Termination of pregnancy details

1 2 3 4 5

Q.26 Obstetric information not stored in an EMR

Is there information that you consider necessary for the practice of obstetrics, but which SHOULD NOT BE STORED in an organisation-wide EMR?

Yes

No

If YES, please specify what information you would NOT WANT STORED in an EMR, but feel SHOULD BE AVAILABLE to anyone involved in the care of your maternity patient.

Q.27 Obstetric information and an EMR

If it was a requirement that any information you transfer to the secondary obstetric service at Capital Coast Health, was entered in the EMR, would this pose a difficulty for you?

Yes

No

If you answered yes, please answer the following statements regarding your probable action:

1 = very unlikely	2 = unlikely	3 = uncertain
4 = likely	5 = very likely	

I would refuse to use the EMR at all.

1 2 3 4 5

I would enter limited information only

1 2 3 4 5

I would enter only limited information but pass on any extra information needed by telephone or in person

1 2 3 4 5

I would enter all necessary information anyway

1 2 3 4 5

Q.28 What does an electronic medical record (EMR) mean to you?

Please describe what an EMR means to you. Does it mean a lot of work, a reduction in your work, is it threatening or do you consider it to be a welcome challenge, is it something you hope never to have to deal with or the answer to all your problems? Feel free to describe an EMR in any way you wish.

Q.29 Expectations

This questions considers what you feel about accessing and using an EMR that is located in a secondary/tertiary care health institution, such as Capital Coast Health Ltd. Please circle one answer for each statement.

1 = strongly disagree	2 = disagree to some extent	3 = uncertain
4 = agree to some extent	5 = strongly agree	

- | | | | | | |
|--|---|---|---|---|---|
| 1. I am apprehensive about using an EMR | 1 | 2 | 3 | 4 | 5 |
| 2. I am keen to use an EMR | 1 | 2 | 3 | 4 | 5 |
| 3. I feel that implementing an EMR that primary health care professionals, such as GPs, midwives, and community based specialists, can access is worth investing time and money | 1 | 2 | 3 | 4 | 5 |
| 4. I feel that implementing an EMR that primary health care professionals, such as GPs, midwives, and community based specialists, can access will have too many problems to be successful | 1 | 2 | 3 | 4 | 5 |

Q.30 Additional information

If you have any concerns about electronic medical records (EMRs) that have not been asked about in this questionnaire or any issues that you would like to address further, please elaborate below. Feel free to continue on the back or on an extra page.

Thank you for completing the questionnaire.

Appendix Four: Cover letter

Dear

Electronic Medical Records

This is an important survey, seeking your views and ideas about computerised medical records.

The survey has been commissioned by because we are developing our own electronic medical record system. It is being circulated to all LMCs with Access agreements at are very supportive of this survey and will be mailing their own members.

We cannot make progress without good information. The best source of this information is from you and the easiest and most accurate way to obtain this information is from a computerised medical record.

The questionnaires are coded so as to facilitate a repeat mail-out to any non-respondents.

Our ultimate objectives are better quality care for your patients and improved working conditions for you. Please help us to plan for this by completing and returning the questionnaire by the 31st December, 1996. It is important.

With best wishes for Christmas and the New Year

Yours sincerely

Chief Executive

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