

Towards a Successful Implementation of Inter-organisational Electronic Medical Records

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Abstract

This paper reports some of the findings of a study which examined the opinions and attitudes of primary healthcare professionals towards a planned inter-organisational Electronic Medical Records (EMR) system which would link the primary and the secondary healthcare sectors.

The research identified a number of issues particularly relevant to the use of an inter-organisational system in the health sector. A significant finding of the survey was that although the different professional groups who would use the system had similar attitudes towards the system, they also had different requirements and would need to be treated differently.

Keywords

medical and healthcare application, personal computing acceptance, small organisations, technology acceptance model, end users, organisational characteristics, IS success

ISRL Categories: AA, DA0201, EL03, FD, GA03, GB, GC, HA09, HB

INTRODUCTION

This article describes the first phase of an ongoing, longitudinal study which examines the attitudes of General Practitioners (GPs) and midwives towards the implementation of an Electronic Medical Records (EMR) system for maternity patients. The planned system will be located within the secondary care or hospital based sector, but it will be accessed by primary care professionals with contractual arrangements enabling access to hospital facilities for their patients. The planned system therefore necessitates inter-organisational communication between disparate professional groups in widely dispersed locations.

This 'shared care' structure, in which patients are seen by a range of professionals within both the primary and secondary care sectors has often led to problems as patient records have often been incomplete and information has taken a long time to travel from one sector to the other.

For some time now the health sector has been seeking to exploit the use of information technology to improve its operational efficiency and to improve the quality of care that it provides for patients. In recent years two key strategies of the Australian and New Zealand Governments in this area have been the introduction of EMRs and improved electronic communications links between primary and secondary care institutions (NHIMAC, 1999; MoH, 1996, 2000).

An EMR is an integrated database system which consolidates the information relating to the healthcare of an individual patient and makes all of the information available to healthcare professionals who are treating the patient (GEHR, 1993). Its aim is to improve the quality of care by ensuring that complete and up to date information is readily available to all caregivers. If the system also consolidates financial and costing information relating to the treatment of the patients, then better financial control and charging mechanisms may also be achieved.

The model of healthcare provision within New Zealand (and most other developed countries) is for patients to consult an primary care organisation such as a GP practice or midwife initially. These primary care practitioners may then refer the patient on to a secondary care institution, such as a hospital, for specialist attention or facilities. In these situations it is important that there is a rapid flow of information between all the parties involved with treating the patient. Under the current structure of the New Zealand health system, the hospital and the primary care sectors are separate and autonomous organisations which receive payment from the government for the services that they deliver. The primary care practitioners usually work in group practices and the practices within a geographical area form associations (Independent Practitioner Associations or IPAs) to co-ordinate their work and to negotiate with the government for payments. The status of midwives within the New Zealand health system is different to their counterparts in some other countries in that they, like GPs, can work independently or within a midwife group practice to manage the maternity care of women.

A large New Zealand hospital is in the process of implementing an EMR system. The first phase of the project is to integrate all of the hospital's internal information systems that relate to patient care. The second phase of the project will be to enable primary healthcare practitioners to access the EMR system from remote locations, such as their consulting rooms. Although these kinds of systems have been proposed and attempted for several years now, their implementation is frequently difficult and unsuccessful (Hannah, 1998; Sicotte et al., 1998). The situation in this particular case is complicated by the fact that the healthcare professionals who will be using the system will be members of several different organisations, this raises concerns and difficulties over issues such as ownership and access to the information and the allocation of costs of systems operation, usage, training etc.

The work reported in this paper is the first stage of an ongoing study of the primary care / secondary care linkage system. This first stage has involved the investigation of the opinions and attitudes of the primary care workers towards the use of the proposed system. The aim of the study has been to identify which factors are likely to encourage or inhibit the adoption and use of the system once it is implemented. The findings of the study will influence some of the details of the implementation process. The second stage of the study will be to monitor the actual implementation, and the third phase will be to conduct post-implementation surveys of the users once the system has been in use for some time.

The study has focussed on the use of the maternity care system. This will be one of the first systems to be available to the primary care sector since it is seen to have the potential to offer some important benefits for patient care. The progress of a routine maternity case typically

involves several interactions with the patient in both the primary care setting and the hospital. Most of the cases then end up arriving in hospital at some unarranged time and it would be useful to have all of the information relating to the pregnancy readily available. With the current fragmented paper-based systems this is often not the case, so an integrated EMR for maternity care is seen to offer some considerable benefits.

The successful introduction of the system is however likely to be problematic. 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 (Bolton et al., 1999; Thakurdas et al, 1996).

In recent years there has been an increase in the electronic transfer of data between the GPs, the IPAs and the Health Funding Authorities and other government organisations (MoH, 1996). This has raised the additional issues of information ownership, remuneration for the provision of information by GPs to other health agencies, and access rights to information about patients. Such issues are also likely to impact upon the uptake of the system.

The next section of this paper outlines the development of the theoretical model used to predict user-adoption of the EMR system. Following sections then describe the methodology used to test the model and analyse the results. The discussion of these results indicates that the concerns of the users of an EMR have a significant impact on the chances of success of an EMR system implementation.

THEORETICAL MODEL OF USER ADOPTION

Rather than developing a completely new model of user-adoption, this project studied the existing models in the literature and adapted and extended them for the particular circumstances of an inter-organisational system for the exchange of patient information.

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) (RNZCGP 1996 and 1997) and between 20-24% of GPs work in solo practices with only 1 or 2 staff (Klijakovic 1996). It is therefore, important to select a theoretical model that has validity for small businesses. One of the few studies looking at end-user computing (EUC) success factors for small firms was conducted by Zinatelli (Zinatelli, 1994, Zinatelli et al., 1996). She developed a research model based on the Technology Acceptance Model (TAM), which was developed by Davis to predict computer usage behaviour (Davis, 1985, Davis et al., 1989). The model and the scales used have been successfully replicated by Davis and many researchers in different IS settings, including in both large and small businesses in different industries (Adams et al., 1992; Davis, Bagozzi and Warshaw 1989; Davis 1993; Moore and Benbasat 1991; Zinatelli 1994). This increases the validity of the model and its measures. It was therefore decided that the TAM would be applied to this special group of small organisations - that of primary healthcare providers.

TAM 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).

However, TAM does not completely explain user adoption and many other studies have identified various other factors which influence the adoption of systems (e.g. Ives and Olson

1984; Cheney et al., 1989; Nelson and Cheney 1989; Doll and Torkzadeh 1989; Winfield 1991; Kivijardi and Zmud 1993; Zinatelli 1994). Such factors include user participation in the implementation process (e.g. Joshi, 1991, Yoon et al., 1995), the provision of training and support (Igarria et al 1995), and some aspects relating to the operation of the system such as access to and use of the data (e.g. Foote 1990; Turnbull 1992; West 1992). The literature review highlighted the fact that medical professionals may refuse to use an EMR despite the perceived ease-of-use and perceived usefulness of the EMR if they consider some aspects of the system to be unacceptable (GEHR 1993; Select Committee on Science and Technology, 1996). These other factors, which relate to aspects of the implementation and operation of the system will be referred to as *system acceptability*.

The theoretical model used for the research is shown in Figure 1 below, it is an amalgamation of the models used by Davis (1993) and Zinatelli (1994) which is extended to include the concept of *system acceptability*.

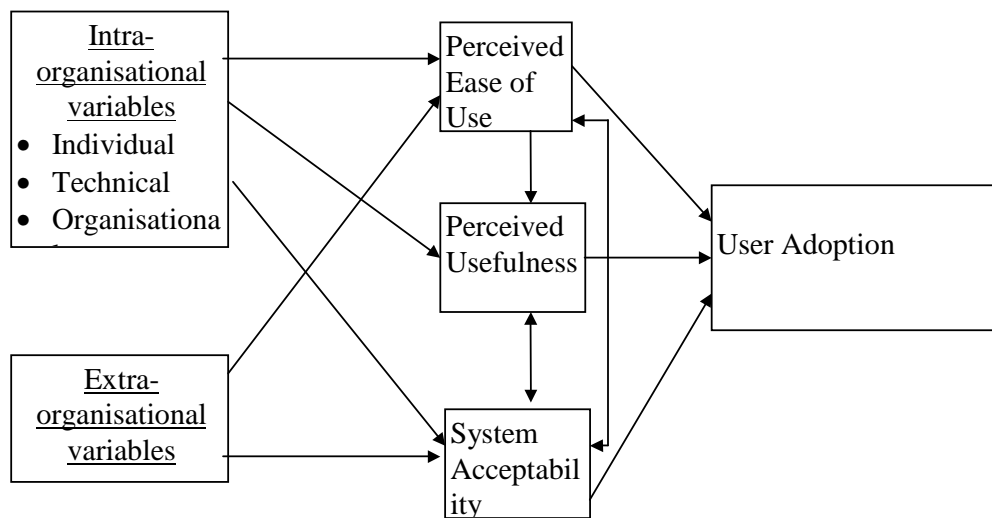


Figure 1: Theoretical Research Model.

Within the proposed model, the key factors which influence the adoption of the system were considered to be: *perceived ease of use*, *perceived usefulness* and *system acceptability*.

Of the large number of contributory factors that influence these key factors, the ones which were considered to be the most important were:

1. Computer Training and Computer Experience
2. External support
3. Internal support and Management support
4. Access and availability
5. Technical issues
6. Personal cost
7. Medico-legal, security, confidentiality and data issues
8. Ownership of the data.

Issues 1 to 6 are important for the success of any information system, but issues 7 and 8 are some specific variables that are relevant to medical computing and EMRs that need to be considered. It is apparent from the literature review that unless the users were comfortable with these factors, an EMR would not be used. Data ownership, copyright, liability, identification, durability, patient record immutability, processing of personal data and transparency are also important medico-legal considerations for the use of an EMR. After discussion with various GPs and midwives, it also became apparent that ownership of the data contained within the EMR is an important issue relating to system acceptability.

The above factors were fitted into the above model of system adoption. A questionnaire was then generated in order to test the model by undertaking a survey which solicited the views of the potential users of the proposed information system. This survey was then used to validate the model and to gain some insights into the most appropriate way to introduce the system.

METHODOLOGY

In order to test the theoretical model of user-adoption, and to gain a better understanding of the potential users' perceptions of the proposed system, a 13-page questionnaire was developed using some questions from published scales of EUC success (Davis 1989; Davis et al 1989; Moore and Benbasat 1991; Adams et al 1992). However, the specific medical context necessitated the development of some new questions and measurement scales which had not been previously validated. A pilot study resulted in some modification to the layout and wording of some questions.

The questionnaire was divided into 2 parts. The first part asked 16 questions relating to demographic details and computer experience of the respondents and to the structure of their practice.

The second part solicited respondents' opinions on 12 key issues concerning the proposed system. Each of these main sections had from 3-18 component questions using either a ranking scale or a 5-part Likert scale. Unfortunately, the questionnaire is too long to be included in this article.

1. Perceived Ease of Use

This was defined as the degree to which the respondent believed that using the computer system would not require a great deal of effort. The measurement scales were 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 was still in the planning stages and had not been implemented at the time of the research project. The measurement scale consisted of items adapted from the TAM with additional items identified within the literature review, Table 1 gives a summary of the issues that were addressed.

2. Perceived Usefulness

This was defined as the extent to which the respondent believed that using the computer system would improve his/her performance. The measurement scales were again adapted from Davis' original TAM. The questions were tailored to the particular context of access to an EMR. Perceived usefulness was measured by the items summarised in Table 2.

3. System acceptability

This relates to the extent that the system that is provided is found to be acceptable to the user. A number of issues are related to the acceptability of an EMR system, such as the:

- ownership and access to data,
- acceptable uses of the data,
- provision of training and support,
- consultation in the development process.

Questions relating to these issues are summarised in Table 3.

Respondents were also asked if there were any other features that would increase the likelihood of them using the EMR, that would be useful for an EMR to perform, or that would make it easier for them to use an EMR. This was to capture any features not identified in the literature review or pilot study. Respondents were also given two open questions providing them with an opportunity to add further comments.

The questionnaire was then mailed to the research population who were identified as the primary healthcare professionals who held contracts with the hospital which allowed them access to the maternity services. In order to encourage a high response rate, the majority of the target population was approached through their professional organisations. A personal letter accompanied each questionnaire, a copy of the results was offered, confidentiality and anonymity was assured. Initial non-responders were reminded with a polite, personal letter and another copy of the questionnaire. A total of 170 questionnaires were sent out and a total of 103 usable replies were received (52 from the GPs and 51 from the midwives), giving a usable response rate of 61%.

RESULTS

Statistical analysis of the survey results involved descriptive analysis, ANOVA comparison of means, univariate correlational analysis, chi-squared testing, using the statistical package with Excel[®] and the statistical program SAS[®].

Each of the questions in the questionnaire which assessed the influence of a particular variable on the respondents' attitude towards the use of the system was found to be statistically significant at the 0.01 level, which indicated that the identified factors were relevant in this case.

The analysis also examined the differences in response to the questions by the different groups of GPs and midwives. Overall the attitudes of the groups were very similar, but there were a few statistically significant differences between the different groups which are discussed below. A full report of the analysis can be found elsewhere in Hunter (1997).

Demographic Characteristics of Respondents

Most of the respondents (75%) fell in the age range 36-50. Compared with GPs, midwives had an earlier year of nursing graduation, were mainly female (98% for midwives, 42% for GPs). Midwives tended to work in smaller groups with 72% of them working in solo practices or in small practices of 2 or 3 midwives, however, the doctors tended to work in larger practices with a median practice size of 5 doctors.

Practice Computerisation

Midwives were more likely to have had computer training but less likely to work in computerised practices. There was a statistically significant difference between the number of computerised doctor practices (92%) and computerised midwife practices (33%). This

indicates that there may be a significant difference in the costs of adopting the EMR for the two different user groups.

However, most of the computers were only used for administrative purposes rather than patient records, so the actual experience of both groups with EMRs is very limited.

Similarities between the Professional Groups

There was little difference between doctors and midwives regarding the importance of *perceived ease of use* and *perceived usefulness*, a summary of the results for the questions relating to these aspects is given in Tables 1 and 2 below. All of these factors relating to these aspects scored highly and were statistically different from a mean value of 3, which would indicate no influence.

Variable	Disagree (1 or 2)	Uncertain (3)	Agree (4 or 5)	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 1: Variables related to *Perceived Ease of Use*

Variable	Disagree (1 or 2)	Uncertain (3)	Agree (4 or 5)	Total	Mean
Decrease workload/pressure	1	2	96	99	4.71
Meets goals/needs of myself, patients, practice or 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
Improving quality of patient care	1	4	95	100	4.66
Improve access to data	3	3	96	102	4.62
Improves communication and information sharing	0	7	93	100	4.59
Assist in improving seamlessness of care	0	9	91	100	4.55
Accessible 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 2: Variables related to *Perceived Usefulness*

These was also a high degree of similarity between the groups regarding aspects of *system acceptability*, except for the few differences noted below, and again the importance of these issues rated as being statistically significant. A summary of some of the results for *systems acceptability* is given in Table 3 below.

Variable	Disagree (1 or 2)	Uncertain (3)	Agree (4 or 5)	Total	Mean
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 expectations and relationships	5	15	80	100	4.05
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
GP representative in implementation	20	27	51	98	3.47
Midwife representative in implementation	8	10	20	38	3.32

Table 3: Variables related to *System Acceptability*

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 rated both of these issues as being important, but there were some differences of opinion between the different groups of respondents. 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.

Primary health care organisation members would be more likely to use an EMR if the support is provided by their own 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. The desired pattern of provision of training followed that for support.

Other Differences between Professional Groups

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

- Slightly more doctors considered system acceptability more important than did midwives.
- More doctors ranked 'benefits exceeding costs' (i.e. *usefulness*) 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 available 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.

DISCUSSION

This section discusses 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.

Perceived usefulness and ease of use

It is important that secondary health care institutions can demonstrate that the EMR is useful and has benefits for the user and/or patient. Since 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.

All the features addressed in the perceived ease of use section also 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.

System acceptability, patient consent, incomplete data

System acceptability 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 major concerns that influence system acceptability of the EMR relate to data variables. Respondents indicated that data contained within the EMR needs to be secure and confidential, accurate and factual and also easily and quickly retrievable, if the system is to be adopted.

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 system acceptability. The degree of concern that respondents have for these areas is highlighted by 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. 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.

The need for computer training and support.

The survey found a general lack of computer experience and computer training amongst the respondents and the low level of computer confidence. Responses to the open question “What does an EMR mean to you?” indicated a high level of apprehensiveness regarding the use of an EMR and, in response to a separate question, 45% of respondents rated themselves as being apprehensive about their use of an EMR. These factors indicate the need for computer training.

However, the provision of this training indicates is subject to some ‘political’ difficulties. 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 several 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. The preferred pattern of support followed that of training.

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. Note that there is also a marked difference in the degree of computerisation between the doctor and the midwives and so the groups will need different levels of financial and technical assistance.

CONCLUSIONS AND FUTURE WORK

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. The degree of ‘selling’ the EMR will need to vary as some respondents will embrace it readily and others will be very resistant to its implementation.

Demonstrable benefits for the users and for their patients are more important for the users than demonstrable benefits for the secondary healthcare organisation. The ability for primary health care providers to opt out of using the EMR altogether needs to be considered. System acceptability is a major variable affecting EMR use and responses indicate that mandatory use is unlikely to be successful. The findings of this study imply that careful attention to the needs of the various user groups is critically important for the successful implementation and on-going use a medical inter-organisational information system.

The findings of this study and the conclusion to be drawn regarding the implementation process have been reported back to the hospital management. The hospital is still keen to proceed with the system in the near future and the project team will be monitoring the implementation process to see how the problematic issues are tackled, this study will enable the impact of the research to be evaluated.

A post-implementation survey of the same population is also planned, to solicit the views of the users once they have had some experience of using the system. The survey will also measure actual usage of the system and this will allow more sophisticated analysis of the data

to be undertaken which will allow the relative importance of the different factors to be determined.

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