A REALISTIC EVALUATION OF THE IMPACT OF A COMPUTERISED INFORMATION SYSTEM ON CLINICAL PRACTICE: THE NURSES' PERSPECTIVE

PhD thesis

Cristina Oroviogoicoechea
School of Nursing and Midwifery
University of Sheffield
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ABSTRACT

A realistic evaluation of the impact of a computerised information system on clinical practice: the nurses' perspective

Aims and objectives. The aim of this study is to explore nurses' perceptions of the impact on clinical practice of the use of a computerised hospital information system.

Background. Information technology systems are rapidly being introduced in clinical practice. Evidence of effective systems implemented effectively in healthcare organisations appear to be crucial for further design and development. Evaluation research of IT implementation is moving from a technical to a socio-technical approach that incorporates user perspectives and context in the evaluation.

Design. A realistic evaluation design based on Pawson and Tilley's work has been used across all the phases of the study. It is a theory driven approach and focuses evaluation on the study of what works, for whom and in what circumstances. These relationships are constructed as context-mechanisms-outcomes configurations (CMO).

Methods. A self-developed questionnaire containing both closed and open-ended questions was piloted and distributed to all nurses working in in-patient units of a University Hospital in Spain (n= 227). Quantitative data were analysed using SPSS 13.0. Descriptive statistics were used for an overall overview of nurses' perception. Inferential analysis, including both bivariate and multivariate methods (path analysis), were used for cross-tabulation of variables searching for CMO relationships. Content analysis of open-ended questions was used to identify major themes in nurses' responses.

Results. 179 nurses participated in the study (78.8% response rate). Overall satisfaction with the IT system is positive and only 7.5% of the nurses wanted to go

back to paper records. Mechanisms and outcomes are highly correlated. Comparisons with context variables show how users' characteristics, except attitude towards the introduction of technology, did not have a significant influence on perceptions while the nursing unit context had greater influence. Path analysis illustrated that the influence of unit context variables are on outcomes and not on mechanisms. Six main themes emerged from open-ended questions: information, communication, patient care, documentation processes, work dynamics and running of the program. Some differences in relation to the unit context were observed.

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1. INTRODUCTION

1. INTRODUCTION

The increasing complexity of healthcare and the increased introduction of information technology have made communication and information management a key element in healthcare organisations.

The availability and potential of information technology (IT) systems and recognition of the inefficiencies of paper records have provoked a rapid incorporation of information system tools for clinical practice. Information technology can help to provide a structured way to access and interpret patient data and, at the same time, provide a variety of information resources to increase the level of knowledge of the nurse decision maker (Henry 1995).

However, tremendous benefits from IT implementation in clinical practice such as accessibility, completeness, decision support and access to knowledge bases can present tremendous challenges when ineffective applications are introduced (Tierney 2001). Thus, the importance of research to determine how IT systems can enhance and support clinical practice. Knowledge gained in this area will support further design and implementation of IT systems in healthcare organisations in a meaningful way.

The evaluation of IT in healthcare, and nursing within it, despite its relevance due to the rapid implementation of IT systems, can be considered to be in its early stages. Limited insight has been developed and many relevant questions for effective design and implementation remain unanswered. A paradigm change in evaluation of IT systems is proposed in the literature moving from a technical to a socio-technical approach, where users and context become key aspects in evaluation.

Further research is needed to guide development and implementation of IT systems and theory driven evaluation research could unlock a new approach to move to a wider perspective in comprehending the impact of IT systems in clinical practice.

This study aims to provide an insight into nurses' experiences using a computerised hospital information system in clinical practice in a teaching hospital in Spain. A realistic evaluation design is used to make sense of the complex relationships between variables included in the evaluation of IT systems and provide a wider view of the long-term impact. Being an under-utilised method, the study provides insight into the utility of realistic evaluation for IT system evaluation research and tries to extrapolate the experience to the potential of realistic evaluation in nursing research.

2. LITERATURE REVIEW

2.1. INTRODUCTION

Quality of care is directly related to the quality of information available to healthcare professionals and charting and managing clinical information is an essential part of their daily work (Currel and Urquhart 2003). This is not a new idea; the complexity of the healthcare context, the need to demonstrate effectiveness in clinical practice and the current transformation of healthcare institutions with the introduction of informatics are some of the reasons for the considerable interest in the process of clinical information and communication during the last decade. The ability to capture data and use data is a hallmark for excellence.

'To perform their services, modern healthcare organisations are profoundly dependent on rich and accurate information collected and shared between multiple organisational levels.' (Anderson *et al.* 2003 p. 47). Information comprises a wide range of aspects including patient specific data, research information and procedure information (Henry 1995). In this context, information technology offers tremendous opportunities to enhance clinical practice and the appropriateness of care and also to increase efficiency and effectiveness in healthcare organisations (Ammenwerth *et al.* 2004). Clinically oriented applications are increasingly being developed and introduced to support the daily work of healthcare professionals (Giuse and Kuhn 2003).

The current paradigm in healthcare is a multidisciplinary approach; it is not one individual profession but a team, which provides comprehensive and coordinated care (Tierney 2001). Care provision is understood within a multidisciplinary context where different professionals have a role with specific contribution and activities, but from the patient perspective provision of care is through teamwork. Hence patient

care depends upon complete and accurate information among caregivers within the team.

Within the information processes the patient record has a central role and nursing documentation is an important part of it (Helleso and Ruland 2001, Bjorwell *et al.* 2000). Patient records are considered the most important tool for information and communication in healthcare organisations and a key element for the continuity and coordination of patient care (Martin *et al.* 1999). Nurses within the team, because of their central role in providing 24 hour care and in co-ordinating the care given by the team, are recognised as 'key collectors, generators and users of patient/client information' (Currel and Urquhart 2003). Safe and high quality care may be considered as outcomes of good patient records.

Data documentation is a major issue within nursing and can be considered an under valued aspect, lacking recognition even within the profession itself. Low quality and time-consuming records are reasons for nurses' low acceptance of documentation (Ammenwerth *et al.* 2001b, Nahm and Postom 2000). Nevertheless, the Nursing and Midwifery Council (NMC) in the UK (2004 p.5) has stated that 'record keeping is a fundamental part of nursing.' The NMC (2004) has issued guidelines specific to records and record keeping and these superseded earlier guidelines in 1998 from the former United Kingdom Central Council for Nursing, Midwifery and Health Visiting. There is a tradition of oral communication for the transmission of the knowledge nurses have about patient conditions (Erdey 2005, McDaniel 1997, Heartfield 1996). Nursing documentation has been highly influenced by legal, management and professional issues, looking to a documentation that fully reflects the work of the nurses and therefore makes nursing visible. Nursing records have

been developed not only for their use as vehicles for storage and exchange of information but they have also been used to support different philosophies of nursing practice (Currel and Urquhart 2003).

The development of nursing documentation has come at the same time as the introduction of the nursing process in clinical settings (Ammenwerth *et al.* 2003b). Studies refer to the difficulty that nurses have in complying with the requirements of this kind of documentation and see it as taking them away from the patient. Nurse documentation has not been explored from the point of view of the nurses use of it for clinical practice, although Higuchi and Donald (2002 p. 150) exploring thinking processes evidenced in nursing documentation found that 'chart data represented a summary of the nurses' thinking processes and the communication of selected information about a clinical situation'. Teamwork, accountability and the need to provide evidence on nursing contribution to patient care are factors contributing to a growing nursing awareness of the relevance of nursing documentation.

It is widely recognised that paper-records do not meet the requirements of today's healthcare institutions (van Ginneken 2002). Information technology can help to provide a structured way to access and interpret patient data and, at the same time, provide a variety of information resources to increase the level of knowledge of the nurse decision maker (Henry 1995). Information and data content should be considered along with ensuring that it is presented in a concise and reliable way that facilitates the decision making process, making it as straightforward as possible (Thompson 2001). With specific reference to information technology, the NMC (2004) produced guidelines saying (p. 12) that 'the same basic principles that apply

to manual records must be applied to computer held records', specifically: security, patient involvement and accountability.

2.2. AIM AND SEARCHING STRATEGY

The aim of literature review is to explore existing nursing research on inpatient hospitals' IT systems and to discuss new approaches for evaluation research on nursing informatics to guide further design and implementation of effective IT systems. Specifically, the literature review aims to help select a strategy for the evaluation which is the focus of the present study.

The literature review was carried out using the electronic databases CINAHL and Medline using the search terms 'nursing information systems', 'clinical information systems', 'hospital information systems', 'documentation', 'nursing records', and 'charting' from 1995-2005. The search sought journal articles, research papers and systematic review but excluded anecdotes, responses, brief items and commentaries as they provide limited evidence (Polit and Hungler, 1993). It was combined with 'electronic' and 'computer' and excluded management and legal publications and those with no more than 10 references. A total of 588 articles were retrieved and their subsequent relevance to the study assessed by manual reviewing of abstracts. In addition, a manual review of the past five years articles in *Journal of American Medical Informatics Association, International Journal of Medical Information* and *Computers in Nursing* was carried out.

The process described by Polit and Hungler (1993) was used for screening references. Potential references were revised based on the abstract, and articles related to full electronic patient record systems or electronic nursing record systems

were kept for review, while those related to specific applications such as medication prescription, decision support systems, laboratory or X-ray images were rejected. In addition articles which focussed only on classification systems and taxonomies were rejected. Finally, as the review refers only to the in-patient setting, articles relating to research carried out in out-patient areas were excluded.

Once the relevant articles were selected and located, a manual search of papers in the reference lists of the systematic reviews was carried out. Articles selected for the review were organised, analysed and integrated in the literature review (Polit and Hungler, 1993).

2.3. RESULTS

A total of 74 articles were selected for full article review, some of these could not be obtained or were rejected for the above reasons, leaving 39 articles to be used for the review.

Potential benefits of IT such as accessibility, readability, completeness, decision-support and access to knowledge bases, are widely recognised and have provoked the adoption of information system tools in healthcare organisations (van Ginneken 2002, Nikula *et al.* 2000, Powsner *et al.* 1998). Nevertheless, authors recognised that the use of information systems for clinical practice is still in its early stages and, as Giuse and Kuhn (2003 p. 107) say, 'truly successful stories are not common', with a large number of healthcare institutions still using manual information processes.

2.3.1. Requirements of IT systems

It is important to take into account that technology is a tool, an enabler to enhance clinical practice and not the driver of clinical practice (Jenkings 2004); therefore, it 'should be judged by its ability to present reliable, relevant data to clinicians in a usable form, when and where needed' (Powsner *et al.* 1998 p. 1619). In this context different requirements of health information systems have been highlighted:

- The need for an integrated patient record that allows health professionals' entry and access to data from different places at the same time. Such a record enhances communication and quality of patient care (Ball *et al.* 2003).

- The need for user involvement in all phases of the implementation including design and evaluation (Currie 2005, van Ginneken 2002, Helleso and Rulan 2001, Rodrigues 2001).

- The importance of organisational issues such as culture, innovation and leadership for effective implementation process (van Ginneken 2002).

Nursing is increasingly involved in studies and research on informatics and the emergence of nursing informatics as a discipline within nursing is evidence of this. 'The practice of nursing has evolved to take advantage of the technology and, in many cases, drive the technology' (Hersher 2000 p. 80). Despite this, the lack of a solid knowledge and research base within the nursing informatics literature is evident and there is a need for further research, publication and dissemination of objective information on implemented health information systems (Friedman and Abbas 2003, Ball 2003, Sleutel and Guinn 1999).

The complexity of the object of evaluation, the complexity of the evaluation project and the motivation to perform evaluation make IT evaluation research difficult but not unachievable (Ammenwerth *et al.* 2003a). The tremendous benefits from IT implementation in clinical practice can be transformed into tremendous problems when ineffective applications are introduced. 'Having too much, poorly organised information can cause as many errors in decisions as having too little information' (Tierney 2001, p. 1). Research is needed to determine the success and effectiveness of IT systems in clinical practice to support and enhance the rapid and wide introduction of IT systems in healthcare organisations.

2.3.2. Indicators of successful IT Systems

Van der Meijden *et al.* (2003) carried out a literature review of determinants of success of inpatient clinical information systems over 10 years (1991-2001) and found that there was no explicit definition of success and it fluctuates over time. Success is considered to be a multidimensional concept which encompasses system, individual and organisational factors. System and information quality are the factors most widely analysed in IT evaluation research and which both individually and jointly affect usage and user satisfaction (Van der Meijden *et al.* 2003).

Studies within nursing focus on electronic record completeness, nurses' satisfaction with information tools and the correlation of nurses' characteristics (such as expertise, level of use of computers and age) with satisfaction. Questionnaires are the method most widely used, together with qualitative approaches including observation, interviews and focus groups. Some longitudinal studies have been carried out looking for changes over time after the introduction of IT systems, both in

quality of documentation and user satisfaction (Nahm and Poston, 2000, Ammenwerth *et al.* 2001a).

Some of the clear benefits of IT implementation are issues of quality of data: being more complete, accurate, up-to-date and reducing redundancy. Nevertheless, the meaning of quality of data needs to be further analysed. Hogan and Wagner (1997), in a review of studies on data accuracy, refer to the lack of sound research in this area, although some ideas can be highlighted. Data accuracy is based on completeness and although data can be considered complete from a theoretical perspective it is not always checked whether the data accurately and completely reflect the patient situation. They highlight how perspectives, completeness and correctness are conditions for data accuracy. Studies of nursing records, both manual and electronic, refer to completeness and, explicitly, they do not address the accuracy aspect (Karkkainen and Eriksson 2003). On the other hand, the focus of much research is on data entry but not on the causes of inaccurate data, a relevant aspect if computerised patient records are supposed to enhance clinical decision making and reduce errors in healthcare organisations.

Another aspect, when looking at quality of data, is usefulness; not just completeness, but meaningful and relevant information for patient care (Urquhart and Currell 2005). Over documentation tendencies containing non-purposeful and superfluous data is a risk associated with the introduction of IT systems (Stokke and Kalfoss 1999). Ammenwerth *et al.* (2001a), in a randomised study comparing computer and paper documentation, found in the computer documentation review unspecific and long, less individualised documentation and too many non-executed tasks. Nurses in

the study recognised that computer documentation is more complete, legible and of better quality.

Records are written once but read many times, so it is important not only to have the right data but to have it in the right format and language that make it comprehensible and usable for clinicians, as Enkings (2004, pp. 312) says: 'it has to be made available in a ready to hand format'. Nygren *et al.* (1998) and Wyatt and Wright (1998) suggest how information design is about managing the relationship between people and information so that the information is accessible to and usable by people and highlights the need to understand how and why clinicians search records and the factors that make it easier. This is an important area of research developed more in medicine than in nursing looking at the interaction between doctors and the medical record. Data from this area have been used to understand the relationship between people and information and therefore to define the characteristics of electronic records to make data accessible and usable by professionals.

2.3.3. Individualised Care and Structured Data

It is widely recognised that structured data entry and the use of formalised nursing language in a Nursing Information System (NIS) can contribute to a better data capture by nurses (Urquhart and Currel 2005, Daly *et al.* 2002, Nahm and Poston 2000). In addition, structured formats and predefined care plans make planning activities easier and more effective and records are more complete (Ammenwerth 2001a). 'However, formal, explicit, general and objective discourse cannot explain the discourse of the particular that is essential to nursing knowledge' (Rodrigues 2001 p. 100). Taking into account that data are accessed by different people at different times, explicit and formal information may facilitate the same

understanding of information for continuity and co-ordination of care, although some richness could be lost. Research into the concept of knowing the patient has defended the failure of formal assessments or information provided in the shift report to reflect the patient situation (Radwin 1995, Tanner *et al.* 1993). Nevertheless, they did not state whether the information was considered to be useless nor how it contributed to the process of knowing the patient. In other words, the extent to which knowing the patient is based on explicit and formal information about the patient has not been studied. Nurses in these studies refer to this kind of knowledge of the patient as being more than what they know about the patient as a result of a formal assessment or explicit data-based knowledge. It implies a personal relationship that allows nurses to recognise changes in the patient response and individualisation of interventions, particularising prescriptions or general rules to this patient in this situation (Radwin 1995, Tanner *et al.* 1993).

Zeitz and McCutcheon (2002) carried out a study on policies on postoperative observations in 75 surgical hospitals. Despite the low response rate (40%) it is interesting to note that a documented, predetermined process, rather than a practice driven one was observed in clinical practice. Structured practice and structured documentation have the potential to present a rigid system of practice where individualised care can be put at risk (Lee 2005a). A balance is needed and IT systems, while enhancing completeness through structured formats, should promote and facilitate individualised care.

2.3.4. User satisfaction

User satisfaction and experiences is another area of interest within nursing literature on IT evaluation research (Ammernwerth and Keizer 2005). Nurses' attitudes have

been defined as a key element for implementation success (Dillon *et al.* 2005, Marasovic *et al.* 1997). Although, conflicting results make conclusions difficult, agreement can be found regarding satisfaction with the timely and efficient retrieval of results with IT systems. Darbyshire (2004) in a study on nurses' experiences using information systems in their daily work describes it as negative and critical. Lee (2005a), despite an overall positive experience, when analysing written comments in questionnaires, corroborates negative aspects in the use of a computerized care plan system from previous quantitative analysis. Time-consuming, not clinically relevant and system problems are some of the IT problems described by users. Attitudes studies have also analysed the correlation between nurses' attitudes and satisfaction with demographic data such as age, prior experience with computers, experience in nursing, educational background, with conflicting results; for example, Sleutel and Guinn (1999) found no significant differences in nurses' attitudes when compared with individual characteristics and Dillon *et al.* (2005) found significant results for age.

2.3.5. Current Issues in Evaluation of IT Systems

Despite the amount of research carried out to evaluate IT systems within healthcare organisations it can be considered as being in an early stage. The following issues are raised:

- There is a lack of quality research and measurement tools. Attempts to conduct systematic reviews make obvious the lack of solid and conclusive research (Moloney and Maggs 1999, Ammenwerth *et al.* 2003b). Friedman and Abbas (2003) found in a literature review of measurement tools from an initial retrieval of 414 citations that only 27 met the inclusion criteria of

report of validity and reliability and re-use of the tool in different studies, and not all criteria were found in any study.

- Studies are more descriptive, focus on technical and not contingent factors (van der Meijden *et al.* 2003). As a result, no conclusions about the relationship between the system, the context, both the users and the organisation, and the results can be inferred. 'Advocates of health care computerization may suggest that the problems identified by these end-users may evaporate when technology improves. This is a fond hope that assumes that such problems are essentially technical rather than social and cultural in nature, but it seems that even the most sophisticated technology will fail in the absence of clear appreciation of the needs, perceptions and experiences of end-users' (Darbyshire 2004, pp 23).

Current research can be considered as giving some insight, but an incomplete picture of IT system implementation in clinical practice. Nevertheless, evolution both in IT theoretical approaches and evaluation research has opened a new road for a more comprehensive analysis of IT implementation.

Berg (2001) introduces what is called the socio-technical approach in the analysis of information systems and the design of the implementation process. He criticises the traditional approach for IT implementation which focuses on the individual doctor or nurse decision making process as a sequence of logical steps and defends the process as a two way process, that 'involves mutual transformation of the organisation by technology and of the system by the organisation' (p. 147). He emphasises the importance of the professional culture and working patterns and the need for

qualitative studies to explore working practices for effective understanding and implementation of information systems. Talking about the failure of many IT implementation projects in clinical practice, Giuse and Kuhn (2003) recognise that the reason could be a direct consequence of technology-oriented rather than social and communication-oriented nature of most healthcare information system (HIS) applications. Patel *et al.* (2000) conducted a study to determine the influences of the use of computerised patient records on doctors' reasoning and documentation practices. They concluded that the use of computerised patient records changes the organisation of information on patient records and produces differences in the use of computerised patient records with the development of personal interaction after some time using it. There is a rising tendency to include social and organisational aspects within evaluation studies of IT in healthcare (Ammenwerth and Keizer 2005).

Within this context there is a change in the perspective of IT designers to a wider understanding of information systems changing the object and approach of evaluation studies. Consideration is being given not just to task-specific solutions but to how technology has an impact on the organisation and the interaction between people and IT to enhance the users' experience. 'Together, people, tools and conversations - that is the system' (Coiera 2003 p. 206). IT systems cannot be evaluated in isolation from other resources and information processes within healthcare organisations.

In parallel, evaluation research is moving from being a mere instrument to measure whether a programme works towards an exploration on how it works, looking at the underlying principles for effective implementation (McEvoy and Richards 2003, Clarke 1999). Evaluation research from this perspective is used to establish the

relationship between theories, processes and outcomes exploring causal mechanisms (Clarke 1999). It can be considered as a theory testing approach where early theory comes from documents, people, prior research and reasoning and it is checked during the evaluation by different methods. Evaluation research incorporates a new perspective from the traditional method-driven approach within either the quantitative or qualitative approach. In the theory driven approach it is the question that drives the methodology and not in the other way round (Pawson and Tilley 1997). This approach seems to cover some of the deficiencies already found in IT evaluation research that highlights the need to study causal relationships and the advantages of a multi-method approach for a more comprehensive picture of the phenomena.

2.4. CONCLUSIONS

It would appear that due to the complexity of the issues, complete evaluation of the implementation of IT systems is not feasible. Successful implementation is a multidimensional concept understood differently by various stakeholders and contextual factors play an important role. Integration of nursing information systems into nursing practice involves more factors than just technology such as education, changing attitudes, cultures, standardised documentation and healthcare practices. 'It is advisable to view a NIS not only as software and hardware, but also as people, organisational structures and processes that allow the collection, processing and use of information in nursing' (Goosen *et al.* 1996 p. 60).

In terms of the proposed study, the study is justified in the sense that considerable work remains to be done to guide the implementation of IT systems in healthcare. In terms of methodology, the literature review points to the need for socio-technical

approaches to evaluate IT systems. With the relatively recent development of realistic evaluation, which can incorporate this socio-technical perspective and also provides a theoretical perspective, this seems an ideal framework for the present evaluation.

This is an evaluation study; therefore, the research questions are established by the needs of the local evaluation and do not arise, as such, from the literature review. However, the literature review and choice of methodology provide evidence that the aims of the study are appropriate and can be addressed.

2.5. AIM OF THE STUDY

The rapid introduction of IT systems for clinical practice urges evaluation of already implemented systems looking not just at whether they work but how and in what circumstances they work. This research could guide further effective development and implementation of IT systems.

The aims of the study are:

- to develop a validated data collection tool on IT evaluation in clinical practice
- to provide a comprehensive evaluation of the implementation of a computerised nursing record as a part of an integrated electronic patient record and variations between different wards units and nurses
- to evaluate the impact of the IT system on nurses practice in terms of data collection and information use and collaboration within the health team
- to describe and explain the system characteristics that positively and negatively influence clinical practice

and, considering the method that is used:

- to analyse the appropriateness of realistic evaluation for IT systems evaluation research

- to extrapolate the usefulness of realistic evaluation for nursing evaluation research

The study is carried out in a University Hospital in Spain. Discussion of the study with the hospital board was conducted to obtain permission to carry out the study and the hospital ethics committee has approved the study (Appendix 1).

Ethical issues

Ethical aspects of the research are related to data collection from patients and nurses. Data from patients are obtained from the hospital statistics database that includes activity data with no reference to information that allows identification of patients. Therefore, anonymity and confidentiality from patients' perspective is guarantee.

All the nurses who could participate in the study were informed and invited to participate by letter providing information about the project and their role, the use of data only for research purposes and the promise of confidentiality. The letter also gave instructions about how to contact me if they needed further information or clarification. Their attendance at the sessions organised to complete the questionnaire and returning the complete questionnaire were considered as their consent to participate.

To minimise coercion to participate because of my position as a senior manager in the hospital, I did not have direct contact with the nurses regarding their participation in the study. They were invited by letter and ward managers were responsible for facilitating their participation once they had expressed their willingness to do so.

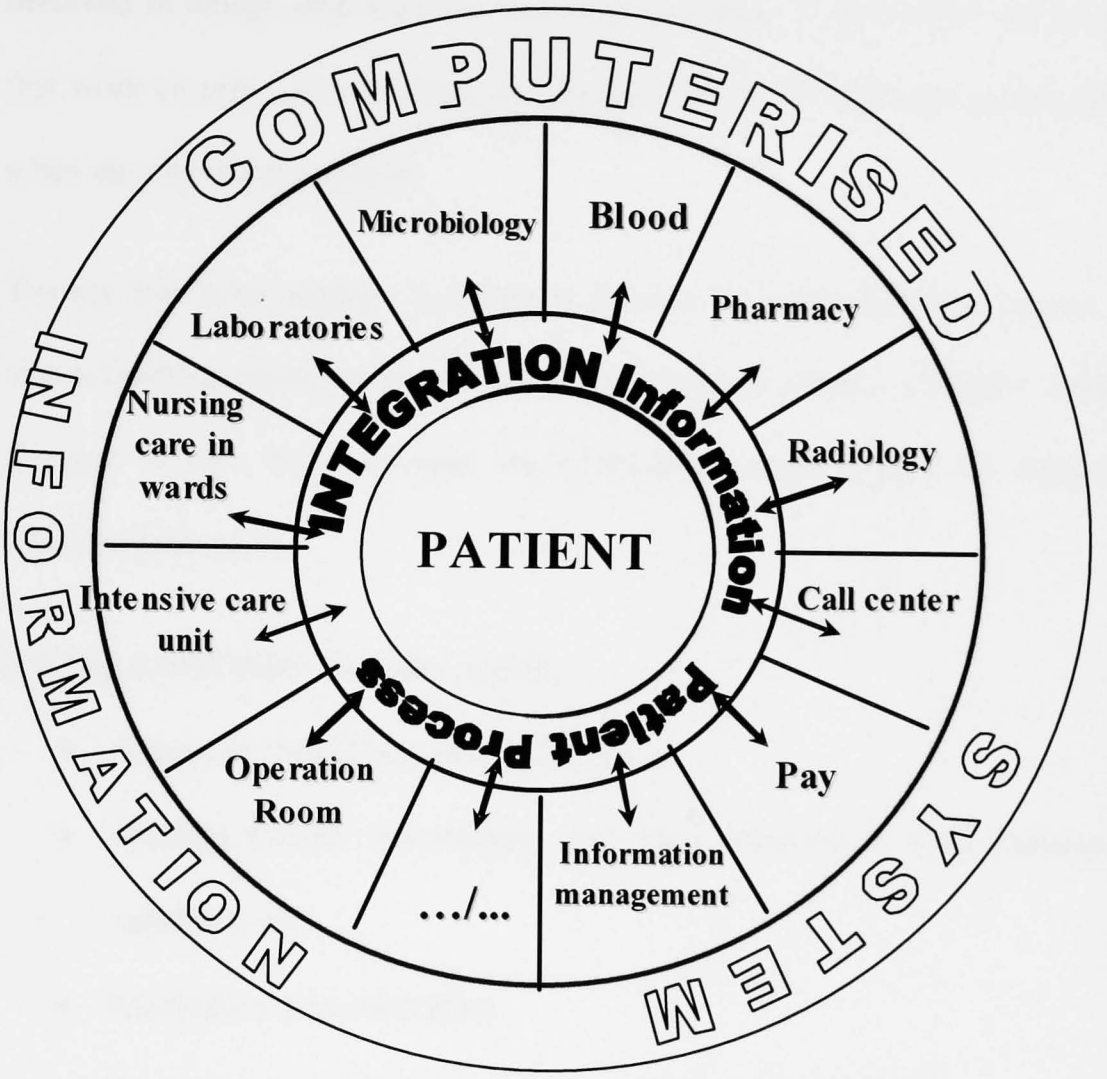
Questionnaires were anonymous and only the units where the nurses were working are identified. A coding system with letters was used to substitute the initial units' names to avoid future identification.

Description of the setting

The hospital is a 400 bed highly specialised teaching hospital situated in the north of Spain. In 1998 the hospital decided on the development and implementation of an integrated computerised hospital information system that would manage clinical, administrative and financial aspects of the hospital. Some applications, mainly for administrative tasks, were already in place but a change was perceived as necessary for a more complete and comprehensive perspective. The vision of the project is represented in Figure 1.1. The patient is the centre of the system which provides a bi-directional communication across the whole organisation, accessing and entering data wherever it is needed and generated.

In January 2000 the system went live, initially with what was already computerised in the old system, but since then the rest of the functions have progressively been introduced. The nursing documentation was fully computerised in 2001 and presently only some parts of the medical record are still on paper. A vendor system fully integrated in the hospital system was initially adapted for the nursing record, but after some years it was decided to move on to develop our own functionality; the cost of maintenance and some problems of communication between the applications were the main reasons. Currently only ICU units are still using the vendor system.

Figure 1.1. Visual representation of the computerised hospital information system



It is a self-developed information technology (IT) system that provides professionals with accurate, quick and appropriate access to the patient record. It is an integrated system with a common way of documenting and accessing information across the hospital by all members of the team. The system incorporates different functionalities to enhance effectiveness of healthcare professionals such as alerts and reminders. The entire system is password driven to ensure the security and integrity of records. Authorisation of access is based on the work profile, based on specific categories of data and specific patients that need to be accessed to perform the job.

One of the principal characteristics, apart from being patient-centred, is that it is a user-driven project. Doctors, nurses and other staff have been and are constantly involved in design and improvement of the system. IT developers are hospital staff that work closely with clinicians and that are aware of hospital workflow and context when developing the system.

Twenty four hour support is available for any problems with the system. There is also a teaching room opened during the day for any person who needs training. Any changes or new functionalities are effectively communicated via Intranet to the whole organisation.

Nursing functionality includes mainly:

- Access to previous patient information
- Nursing record: assessment, care plan, evaluation, fluid balance, clinical variables, etc.
- Medication administration
- Co-ordination and management of patient orders and tests
- Access to medical record
- Access to test results

In summary, the study provides an adequate setting for evaluating IT systems. A computerised information system for patient records has been in place since 2000 and, although the introduction of the different applications is still in progress, the nursing documentation has been fully computerised since December 2001. Therefore, for the period in which the study has been carried out, nurses had at least three years experience using the system and it is possible to refer to them as

competent in its use and with enough experience to evaluate long-term impact of the implementation of the IT system in clinical practice.

3. RESEARCH DESIGN AND METHOD

3. RESEARCH DESIGN AND METHOD

Realistic evaluation emerges in the context of theory-driven perspectives of evaluation research. It has its origins in the philosophical perspective of critical realism, which has as key features: generative mechanisms, the stratified character of the real world ("embeddedness") and dialectic interplay between social structures and human agency (McEvoy and Richards 2003; Pawson and Tilley 1997). Critical realism opens up a new approach within social science research. "Reconceptionalising social and human sciences from a realist philosophical standpoint offers the possibility of understanding and, to some extent, explaining the regularities of the social world while avoiding the dead ends of positivism (Connelly 2007, pp 935). It has informed the work carried out in different fields: economics, housing organisations, education, evaluation, etc (Connelly 2007; Clark et al 2007). The potential of critical realism is widely recognised in organisational studies (Leca and Naccache 2006; Reed 2005) although it still has few empirical applications. From the evaluation perspective Pawson and Tilley's (1997) work on crime prevention and Kazi's (2003) work on social interventions are some examples of the application of the critical realism approach to evaluation research.

The main aspect is that of generative mechanisms based on causality being not external, but an internal potential of the programme or intervention that is activated in the right conditions. "Generative mechanisms may remain latent until they are activated in the right circumstances" (McEvoy and Richards 2003, p. 412). The question that arises is why or how this works in these circumstances (Wilson and McCormack 2006; Forbes and Griffiths 2002). Context, mechanisms and outcomes are essential parts of evaluation research and realistic evaluation examines the

relationships underlying them, what works for whom in what circumstances (Pawson and Tilley 1997). Theory is constructed as different configurations of context-mechanism-outcomes that explain the phenomena under study.

Context-mechanisms-outcomes configurations are generated and expressed as hypotheses. Different methodologies and data collection methods are used based on the research questions. It is not an experimental approach as it does not manipulate the context; and it is not a constructivist approach as data construction is guided by the researcher's theory (Pawson and Tilley 1997).

Although realistic evaluation has not already been widely used in nursing research it is often cited within nursing literature on evaluation research and, positive features identified, can suggest a promising future for its use in nursing research. "Critical realism promises much as an approach that encourages us to look beyond surface appearances in order to search for the underlying processes that account for natural and social phenomena. The challenge for nurses who adopt a critical realist standpoint within evaluation research is to demonstrate its practical efficacy and show that it offers more than speculative theory and critique" (McEvoy and Richards 2003, p. 418). Some nursing studies have used realistic evaluation (Tolson et al 2007; Bying et al 2005). McCormack and Slater (2006) use realistic evaluation from a more explanatory perspective, looking at the identification and explanation of regularities to make sense of the reality and, therefore, generate theories for further research; the focus is more on theory development than on theory testing.

IT system implementation can be considered as a multidimensional open system from the socio-technical perspective with potential benefits that will be achieved in specific circumstances. Overall success is difficult to define; it has many dimensions

and, in addition, different parties can have different opinions about their relevance (Ammenwerth et al 2003a; van der Meijden et al 2003; Berg 2001). "The question about the success of a system, then, becomes the question of success *for whom*" (Berg 2001, p. 145). Contextual factors also play an important role and should be taken into account and make each a unique one (van der Meijden et al 2003; Berg 2001; Heathfield 2001). "Freezing the environment during the study period is neither useful nor possible" (Ammenwerth et al 2003a, p. 127) and, therefore, experimental designs appear difficult to carry out and incomplete for a comprehensive picture. Multi-method and flexible approaches to evaluation research are needed (Ammenwerth et al 2003a; van der Meijden et al 2003). "In evaluation of information systems that employ multiple methods, the data from different sources complement each other to provide a more complete picture" (van der Meijden et al 2003, p. 242). From this perspective, realistic evaluation may be an appropriate method for a more comprehensive approach to IT implementation. In this study, realistic evaluation provides not just the methodology but also the theoretical framework. Other designs or frameworks could have been used, such as action research, case study or change theory, but the way realistic evaluation approaches the phenomena of a study gives the possibility of a wider and more comprehensive picture of IT. An IT system has to provide the reasons and resources to enable users to obtain the outcomes and it is the action of the different stakeholders that makes them work (Carlsson 2003).

Realistic evaluation provides configurations of context-mechanism-outcomes that explain the underlying relationships to understand why and how a programme or intervention works, in this case the implementation of an IT system for nursing documentation in clinical practice. Because of the lack of sound research to guide

initial development of hypotheses based on context-mechanism-outcomes (CMO) configurations, a theory formulation and development design is used (Pawson and Tilley 1997). 'Even in circumstances where the relevant mechanisms affecting the programme outcomes are not yet identified, the realist inquirer may strive to analyse the available data in the search for explanations, and to pave the way for the identification of the relevant mechanisms in the future" (Kazi, 2003, p. 22). Based on the literature review, the study looks at the specification of the different contexts, mechanisms and outcomes involved in nurses use of a computerised program in clinical practice and brings about a possible model based on CMO configurations that could guide further research. A realistic approach is used across all data analysis and the study combines different methods to understand nurses' perspectives and underlying mechanisms.

Therefore, context, mechanisms and outcomes are the main focus of the research:

- Outcomes: Does electronic nursing documentation meet its goals?
- Context: What features within the hospital, the ward units and the users that facilitate or limit its effectiveness?
- Mechanism: how the IT system works to support clinical practice and guarantee quality patient care?

Different types of data collection have been used for the evaluation:

- Information on the characteristics of the wards units and (type of patients, ratio nurse/patient, leadership, etc.), demographic data of nurses using the system (age, years of experience in nursing, computer literacy, etc.).
- Opinion and experiences of key stakeholders: nurses using the IT system in clinical practice.

Phases of the study:

- Specification of contexts, mechanisms and outcomes involved through an extensive questionnaire specifically developed for the study and distributed to all nurses working in the nursing wards. The questionnaire included most of the aspects related to the implementation of IT systems in clinical practice from the system, the user and the organisation perspective. The six domains used by van der Meijden et al (2003) for the review of successful factors of IT systems in clinical practice has been used as framework for questionnaire development: system quality, information quality, usage, user satisfaction, individual impact and organisational impact.
- Results from the questionnaire have been analysed looking for regularities, apparent associations that explain possible CMOs configuration.
- Cross-case analysis of the results from the different units and nurses characteristics perspective is carried out to design a possible model based on cases with demonstrable varying differences in user and organisational factors.
- Critical CMOs are proposed for further research based on their relevance in accordance with the literature review and the opinion of nurses.

4. INSTRUMENT DESIGN

4.1. QUESTIONNAIRE DESIGN

A questionnaire to gain insight into nurses' experiences was designed for the first part of the study. The main objectives of the questionnaire were to:

- Provide a broad perspective of nurses' experiences using the information system in their daily work
- Specification of contexts, mechanisms and outcomes involved in nurses' use of information systems

Principal items were drawn based on an overview of the existing literature and specifically from the literature review carried out by van der Meijen et al (2003) on determinants of success of inpatient clinical information systems. These elements were used to draft a preliminary list of items that were important to measure and distributed within the main areas of the questionnaire:

- demographic data of nurses and ward unit where they work
- development of the program and support for users
- characteristics and system quality of the running of the program
- adaptation of the program to the daily work of the unit
- quality of the documentation associated with the program
- impact of the use of the program on nurses' work and on the organisation

This preliminary list of items was distributed and discussed with two of the hospital's experts: the information technology nurse and one of the support nurses for information system implementation. Literature review and discussion with experts have been considered as elements for exploratory work when deciding upon the

content of a questionnaire specifically designed for research purposes (Murphy-Black 2006).

Areas and items from the reviewed list were organised within the context, mechanisms and outcomes classification (Pawson and Tilley 1997) to clarify the theoretical framework and guide further analysis of results. A sample of components can be seen in Table 4.1.

Table 4.1. Classification of items included in the questionnaire

Aspects	Areas	Elements
CONTEXT	Users	Age, ability with computers, experience at work
	Unit*	Type of unit, type of patients, occupancy rate, DRG**, weight
MECHANISMS	System development	Communication with IT developers, IT support, users' implication in development
	System characteristics	Ease of use Documentation time Response time Security Adaptation to workflow Problems
	Quality of information	Complete Reliable Comprehensive Availability
OUTCOMES	Communication	Nursing team, health team, different units/services
	Users' satisfaction	Attitude, involvement, suggestions
	Patient care	Quality of documentation and information processes Impact on patient care
	Research	Use of data for research

*Unit characteristics were developed based on hospital data, items are not included in the questionnaire except the identification of the ward nurses are working in
**DRG: Diagnosis-related group

Once the content was agreed I wrote a preliminary draft of the questionnaire. Preparation and design of the questionnaire is the most important stage. "The data collected can only be as good as the questions asked" (Murphy-Black 2006, p. 367). Suggestions from the literature were taken into account looking at length of the survey, order of the questions and appearance of the questionnaire (Jackson and Furnham 2000). Both open and closed-ended questions were considered for inclusion in the questionnaire. The advantages and disadvantages were considered taking into account the ability of open-questions to "provide forthright and valuable insights into people's perceptions of the issues involved and to get a feel for the words and phrases that they use" (Jackson and Furnham 2000, p.116). Closed questions comprise all types of responses, from "yes/no" responses to rating scales. Some of the closed questions have an associated open question allowing the possibility of elaborating the response.

Distribution of the questions within the content areas, as well as wording and comprehension of questions, was checked with the IT experts involved in the item development phase. Changes were introduced and a final draft of the questionnaire was produced (Appendix 2). It comprised a 43-item questionnaire divided into the principal content areas, combining open and closed questions to allow an objective evaluation of satisfaction and attitudes together with a description of the personal experience of nurses. Closed-questions about perception of the use of information technology use a five point Likert rating scale, from "strongly agree" to "strongly disagree"; a middle point has been considered to allow nurses to express a neutral attitude (Jackson and Furnham 2000). Questions were grouped as follows in six dimensions:

- Demographics

- Development of the program and support
- Characteristics of the running of the programme
- Adaptation of the program to daily work
- Characteristics of information of the program in general
- Outcomes and impact

4.2. PILOT STUDY

A pilot study of the questionnaire was carried out to ensure, before distribution, that it was clear and understandable and to check reliability and test-retest reliability. The pilot involved both qualitative and quantitative approaches (Jackson and Furnham 2000). Nurses from the different units in the hospital that would be involved in the research, one from each ward, were invited to participate in the pilot. Participants took part in two sessions; during the first one they were asked to complete the final draft of the questionnaire and afterwards they were asked about obvious problems in completing it. The second session took place a week after and participants were asked to complete only the closed questions from the questionnaire for test-retest reliability. To guarantee anonymity and identification of the two questionnaires from each nurse, I did not pre-code the questionnaires and participants chose a number to identify both the first questionnaire and the second one. Ten nurses agreed to participate and I informed each one about the objective of, and their role during, the pilot.

During the first session nurses were informed about the objectives of the study and specifically of the questionnaire Their role during the pilot was reinforced. After the explanation they answered the questionnaire. Time taken to complete the questionnaire ranged from 50-60 minutes. Once they had finished, a discussion about

their opinion of the questionnaire was carried out looking at whether it was clear and understandable but also about completeness and relevance of the content (Polit and Hungler 1993). A set of questions guided the discussion:

- General impression of the questionnaire: easy, attractive, interesting
- Was the information about the project clear and sufficient?
- Were instructions to complete the questionnaire clear?
- Were the headings of the different sections useful?
- Do you consider the order of the sections and questions logical?
- Do you consider questions relevant to the aim of the study?
- Have you missed some question or topic with relation to the aim of the study?
- Are there questions that you found difficult to answer?
- Are there questions that you found vague or ambiguous?
- Are there questions that you would not include in the questionnaire?
- Have you felt compromised on having answered some questions?
- Do you think the design of the questionnaire is clear and attractive?

The general impression of the questionnaire was that it was long but not boring and a general comment from all the participants was that "You have to think to answer open questions". Information about the project and the questionnaire and instructions on how to complete the questionnaire were regarded as adequate.

Questions included in the questionnaire were considered relevant for the topic and they would not exclude any of the items or include new ones. There were no ambiguous questions or ones they felt uneasy about answering. In relation to the questionnaire design, the layout of the questionnaire and the sections and question ordering were satisfactory.

Participants made some reasonable suggestions to specific questions and changes were introduced in response. Table 4.2 summarises the problems or comments of the participants and how they were incorporated in the final questionnaire.

Table 4.2. Problems of participants with specific questions and solutions.

Question	Problem	Solution
12	Depend on the problem they contact one or another, no right answer	Change to: most of the problems you face you usually solve them asking...
15	Questions on confidentiality: in the discussion they tend to make comments specifying the problems they usually have	Add an open question for comments on confidentiality
20-23	Questions about the aims and barriers of good patient documentation: they did not understand the questions very well and it took a lot of time to answer	Simplify the one about the aims: open question instead of "give 3 aims". The one on the barriers I will keep but just alter the wording slightly
29	No middle point, just choose between: more difficult/more easy, more stressful/less stressful	I am not very sure about adding a middle point such us "no affect at all"
30-31	They thought both questions had the same answer	Only one question
17 and 38	Not clear that it refers to the nursing record	Make it explicit

4.3. VALIDITY AND RELIABILITY OF THE QUESTIONNAIRE.

Validity and reliability issues were addressed during the process of questionnaire design and the pilot study.

Validity looks at "whether the questionnaire measures what it is intended to measure" (Murphy-Black 2006, p. 375). Different approaches have been described in the literature (Murphy-Black 2006; Jackson and Furnham 2000; Polit and Hungler 1993). In this study, content validity was assessed to guarantee that items used within

the questionnaire cover the construct under study (DeVon et al 2007; Murphy-Black 2006). It was addressed during the questionnaire design phase by contrasting items generated with the literature on information technology in nursing and with the revision of items generated by two experts from the hospital.

During the pilot study, face validity was checked through discussion with participants after answering the questionnaire. They were asked about the relevance of items included in the questionnaire and if they missed or took out any question. Face validity "does provide insight into how potential participants might interpret and respond to items" (DeVon et al 2007, p. 157).

"Reliability refers to the extent to which a questionnaire would produce the same results if used repeatedly with the same group under the same conditions" (Murphy-Black 2006, p. 376). Bryam and Cramer (2005) differentiate between internal and external reliability. External reliability looks at the "degree of consistency of measure over time" (p. 76) and internal reliability looks at the internal consistency of items within a scale. Test-retest reliability and Cronbach's alpha were the methods used to analysed external and internal reliability, respectively.

Cronbach's alpha of 0.7 or above can be considered adequate (DeVon et al 2007; Watson et al 2006). As the questionnaire during the pilot was administered twice for the test-retest purposes Cronbach's alpha has been calculated for both. Cronbach's alpha for all the items included in the different scales is 0.88 in the first questionnaire of the pilot and 0.93 in the second questionnaire. Therefore, there is intercorrelation between items in the questionnaire which can be considered to measure perception of information technology. Looking at the internal consistency of the different dimensions, some differences were seen (Table 4.3). Although results from the

second questionnaire in the pilot show higher results, only results from three scales can be considered adequate (Development of the program and support, Characteristics of the running of the programme, Outcomes and impact). Despite low results in the other three scales, which can be considered to have acceptable values of Cronbach's alpha, no modifications to the final questionnaire have been introduced in relation to items included in the different scales. Taking into account the high internal consistency of the total items measuring the perception of nurses, initial constructions within the questionnaire drawn from a theoretical approach, will be tested using factor analysis to enhance internal consistency and the dimensions generated will be the ones used for data analysis.

Table 4.3: Cronbach's alpha scores for scales within the questionnaire during the pilot test

Question	Items	Cronbach's alpha *
Development of the program and support	7	0.69; 0.77
Characteristics of the running of the programme	6	0.70; 0.81
Adaptation of the program to your daily work	6	0.70; 0.62
Characteristics of information of the program in general	6	0.47; 0.58
Quality of nursing documentation	6	0.68; 0.60
Outcomes and impact	11	0.83; 0.83

*First value of Cronbach's alpha corresponds to the first time questionnaire and the second to the second

Test-retest looks at the stability of results of individuals across time and it was done administering the same questionnaire to the ten nurses participating in the pilot at one week interval. Test-retest reliability was established using the intraclass correlation coefficient (ICC) to assess the strength of agreement between the scores at time 1

and time 2 (a week after). The ICC to calculate the test-retest reliability is a better measure than the Pearson's product-moment correlation as "this approach uses analysis of variance and allows the calculation of error variances from each source" (Yen and Lo 2002, p. 59). A two-way random effect model was selected as error variances could come from different sources and variables can be considered random (Yen and Lo 2002). There is no consensus about the significance of ICC results and Kanste et al (2007) point out that, although values = 0.80 has been suggested as good, a value >0.50 has been proposed as sufficient. Most of the ICC results are high and only the dimension of characteristics of information is lower than 0.7 (Table 4.4). Therefore external reliability of the measure can be considered adequate and no modifications have been made to the questionnaire.

Table 4.4. Test-retest results

Question	**ICC**	**95%CI**	**F**	**df**	**p**
Development of the program and support	0.725	0.219-0.924	6.286	(9,9)	0.006
Characteristics of the running of the programme	0.652	0.082-0.924	4.744	(9,9)	0.015
Adaptation of the program to your daily work	0.718	0.205-0.922	6.100	(9,9)	0.006
Characteristics of information of the program in general	0.469	-0.185-0.835	2.770	(9,9)	0.073
Quality of the information of the nursing record	0.893	0.630-0.972	17.733	(9,9)	0.000
Outcomes and impact	0.896	0.638-0.973	18.234	(9,9)	0.000

ICC: intraclass correlation coefficient; CI: confidence interval; p: statistical significance

In addition, the paired samples t-test was used to confirm there are no significant differences between the mean scores for each question in time 1 and time 2. All the results were not significant (table 4.5).

Table 4.5. Mean (SD) and t-test significance of comparisons at time 1 and time 2

Question	**Time 1**	**Time 2**	**p-value for time2-time1**
Development of the program and support	1.78 (0.39)	1.78 (0.39)	1.000
Characteristics of the running of the programme	2.61 (0.62)	2.41 (0.56)	0.234
Adaptation of the program to your daily work	2.01 (0.57)	2.0 (0.57)	0.901
Characteristics of information of the program in general	1.81 (0.42)	1.88 (0.33)	0.606
Quality of the information of the nursing record	1.96 (0.42)	2.01 (0.41)	0.434
Outcomes and impact	2.0 (0.42)	1.89 (0.39)	0.096

5. DATA COLLECTION

5. DATA COLLECTION: QUESTIONNAIRE DISTRIBUTION

All nurses working in the in-patient area of the hospital (n= 227) were invited to participate. I sent a personal letter to each of the participants explaining the aim of the research and inviting them to participate (Appendix 3).

Results from the pilot produced the final version of the questionnaire (Appendix 4) and guided the design for data collection. Murphy-Black (2006) suggests that longer questionnaires have no impact on the responses when compared with shorter ones but they do have an impact on response rates, which are inferior in longer questionnaires. To guarantee a higher response rate and to facilitate completing the questionnaire I organised sessions where nurses could come to complete the questionnaire and not be interrupted by day to day activity on the wards. I met individually with all ward managers to obtain their cooperation in allowing nurses to attend the organised sessions. The best days and timetables for the workflow of the wards were agreed. I sent a personal letter to ward managers with the timetable and places of the sessions and a letter reinforcing their role in the research process (Appendix 5). During the process of data collection, response rates from the different wards were reviewed daily and new sessions were organised to facilitate nurses' participation in accordance with ward managers.

I introduced the sessions explaining the aim of the research and the questionnaire, clarifying those questions considered by the pilot group as more confusing. The information technology expert nurse stayed in the room while nurses were completing the questionnaire to answer any questions or collect any comments from the participants.

After two weeks 179 questionnaires were collected (78.8%) which it was considered adequate. The response rate within the different units was higher than 50% (Table 5.1) in all of them so results will be considered as representative also for the different units individually.

Table 5.1. Distribution of the sample within the different units and response rates.

Unit (type of unit)	Sample number (n)	Responses (n)	Response rate (%)
A (ICU)	32	26	81.25
B (ICU)	15	10	66.67
C (medical)	18	15	83.33
D (medical/surgical)	22	18	81.82
E (medical)	18	9	50.00
F (surgical)	13	10	76.92
G (medical/surgical)	22	15	68.18
H (medical)	11	10	90.91
I (medical)	24	14	58.33
J (surgical)	20	20	100.00
K (medical/surgical)	20	16	80.00
L (medical)	12	10	83.33
Total	227	179	78.85

Questionnaires were anonymous and only the ward where participants were working is indicated. This permitted analysis of the context factors related to the unit.

6. METHODS FOR QUANTITATIVE DATA ANALYSIS

6. METHODS FOR QUANTITATIVE DATA ANALYSIS

Data were entered and analysed using SPSS 13.0. After entering data, they were checked and cleaned by examining ranges and means and missing values. Illogical or questionable values were changed (Freeman and Walters, 2006a). Data analysis includes both descriptive and inferential and both univariate and multivariate statistics.

To identify the type of data is a crucial step in the process of analysis as it will guide the selection of the appropriate method for analysis. Different types of data have been identified in the questionnaire. Variables related to the context, both the users' characteristics and the units' characteristics, include interval data (years working, time working as part-time, mean number of patients, occupancy rate, etc) and categorical data (attitude towards the introduction of technology, computer at home, type of patients, type of unit, etc). Age is the only ordinal data as a grouping scale was used to measure it. Data related to mechanisms and outcomes include some categorical data but mainly multi-item Likert scales measure them. Multiple-item scales strictly speaking are ordinal but can be considered interval and most researchers currently treat them as such (Bryman and Cramer, 2005). Scores of the items included in the different scales were summed and a total mean calculated for each of the scales and used for the analysis. Mean scores are a better index as they avoid bias related to missing data and, on the other hand, "the mean score corresponds to answers to the individual items" (Bryman and Cramer 2005). Less than 10 per cent missing data is considered as valid to calculate and use mean scores (Bryman and Cramer 2005).

6.1. FACTOR ANALYSIS

Factor analysis was carried out to test underlying dimensions that were theoretically developed from the literature. Factor analysis is a method of data reduction (Watson and Thompson 2006; Bryman and Cramer 2005). "Factors analysis disentangles complex interrelationships among variables and identifies which variables go together as unified concepts or factors" (Polit and Hungler 1993, p. 306). It transforms a set of interrelated variables into fewer sets of factors that explain as much variance in the original variables as possible.

Conditions for adequacy of factor analysis:

1. Sample size for reliability of the factors emerging: there are no specific criteria about sample size. As a general rule there should be more participants than variables but authors recommend a minimum of 1:5 items to subject ratios.
2. Correlation significant between the items: Bartlett's test of sphericity is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated.
3. Kaiser-Meyer-Olkin (KMO) statistics may be used to address multicollinearity in a factor analysis. The KMO measure of sampling adequacy is an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. Large values for the KMO measure indicate that a factor analysis of the variables is adequate.

Bryman and Cramer (2005) differentiate between exploratory and confirmatory factor analysis depending on whether or not results are compared to a particular model; in the exploratory factor analysis only examination of the relationship between variables is examined and in the confirmatory factor analysis results are

compared. The problem with confirmatory factor analysis is that it assumes zero loading on non-putative factors making it hard to confirm hypothesised factors structures (Hurley et al 1997). Exploratory factor analysis is also used to test construct validity of instruments (Polit and Hungler 1993) and is considered adequate under most circumstances (Watson and Thompson 2006).

In factor analysis there are some decisions to be made: the method of factor extraction, the type of factor rotation and the number of factors to be used. Within the different methods for factor extraction, principal components analysis has been selected for this study. Although strictly speaking principal component analysis is not purely a factor analysis method, Watson and Thomson (2006) explain how differences between extraction methods have been poorly discussed by authors and solutions from factor analysis and principal component analysis techniques do not differ greatly. They conclude and, in their review, treat principal component analysis as a method of factor analysis. In this method, factors will explain all the variance in each variable and as a result communality is assumed to equal one.

Different methods have been described for calculating the number of factors: the Kaiser's criterion based on Eigenvalues and the Scree test. Eigenvalues >1 has been widely used. Some authors refer to the risk of unquestioning results from this perspective (Watson and Thompson 2006; Jackson and Furnham 2000) and suggest a combination of methods that also includes the Scree test. In addition, a subjective evaluation of the meaningfulness of the factors loaded is needed; "the point at which a factor analysis can be considered complete is when resulting factors are meaningful and some iteration between the mathematical techniques and common sense is required" (Watson and Thompson 2006, p. 332).

Rotation is carried out for an adequate identification and characterisation of factors and, therefore, to increase interpretation of results (Bryman and Cramer 2005; Polit and Hungler 1993). "The purpose of rotation is to distribute the variance in the data across the selected number of factors to maximize the loading (the correlation) of items on factors, thereby producing a derived solution" (Watson and Thompson 2006, p. 332). There are two kinds of rotations, orthogonal and oblique, depending on whether it is assumed that factors are unrelated or related respectively. Bryman and Cramer (2005) suggest that, although results from the orthogonal rotation produce no redundant information, they are more artificial. There is no general rule to choose and it is a case of judgement by each individual (Ferguson and Cox 1993). Decision of which one to choose is a matter of preference or deciding on the simplest structure; one whereby item loading on putative factors is maximised and other loadings are minimised (Watson and Thompson 2006).

In this study, factors can be considered as correlated to each other because all try to measure mechanisms involved in the use of IT systems in clinical practice and oblique rotation is carried out to maximise the loading of items in the factors generated. After rotation, the decision about item allocation in relation to the factors is mainly based on the magnitude of the loading and the loading in more than one factor but here also emerges the subjective aspect of factor analysis. Items loading in the different factors have to make sense to the researcher and factors have to be labelled to assure they are not arbitrary (Watson and Thompson 2006). A decision about removing items implies the whole factor analysis being carried out again without items removed (Ferguson and Cox 1993).

6.2. DESCRIPTIVE ANALYSIS

Descriptive statistics were used to assess demographic characteristics of users and ward units and to give a global overview of the perception of the users. Mean and standard deviation were used for interval and ratio data and percentages for nominal and ordinal data.

6.3. INFERENTIAL ANALYSIS

Variables were compared for differences and relationships following the realistic evaluation design. Comparisons and correlations among variables were carried out to test possible context, mechanisms and outcomes relationships that could guide further development of CMO configurations.

Mechanisms and outcomes were considered the dependent variables and only those considered ordinal and interval were used for analysis. Context variables, both unit and users were the independent variables. Figure 6.1. is a diagram of the variables included in the analysis and the directions of the analysis.

To select the method aspects suggested by different authors have been taken into account: the question or purpose of the analysis, the type of data (level of measurement) and normal distribution (Freeman and Walter, 2006b; Bryman and Cramer, 2005).

Comparisons between the variables were made considering groups compared as independent and the use of parametric or non-parametric tests was based on the level of measurement of the data as normal distribution, the other conditions for parametric tests, were assumed because of the sample size (Lumley et al 2002). "An important finding from mathematical statistics (the central limit theorem) states that,

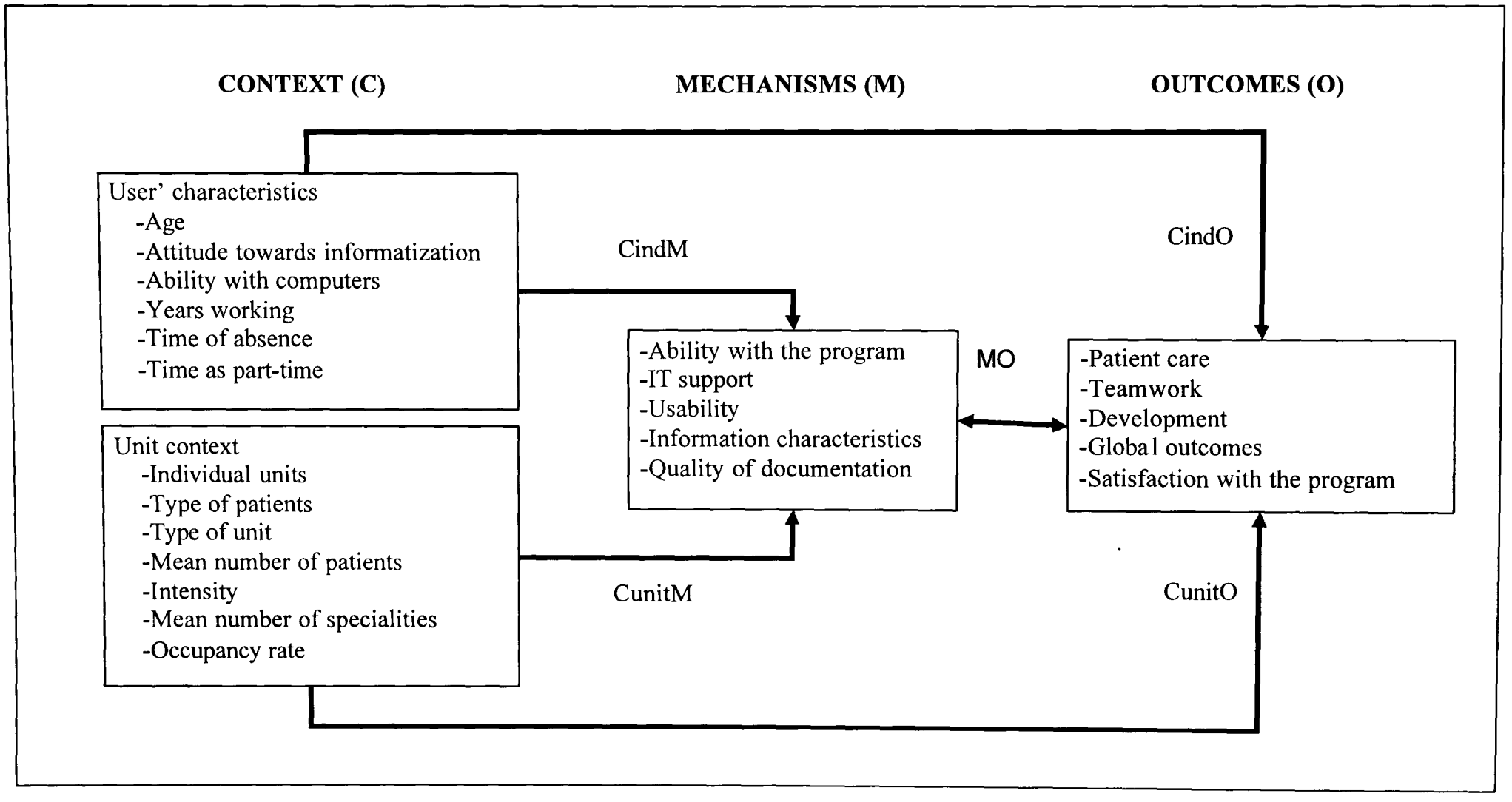
providing the sample size is large enough, the sampling distribution of a mean will be normal even if the distribution of individual observations is not" (Tilling et al 2005, p. 511).

For categorical independent variables non-parametric tests (Kruskal-Wallis and Mann-Whitney) were used for ordinal data (ability with computers and satisfaction with the program) and parametric tests (ANOVA and t-test) for interval data (scales of the different factors for mechanisms and outcomes). Levene's test was used to choose the adequate t value depending on whether the variances were or not equal. Post-Hoc Bonferroni test was carried out with the ANOVA to identify where the statistically significant difference in variances were. For ordinal and interval independent variables Pearson correlation was used.

Statistical significance 0.05 and Bonferroni test have been used to minimise Type I error and Type II error has been controlled in accordance to Cohen's (1992) statistical power analysis that establishes the sample size in relation to significance criterion, the statistical power and the effect size. The sample size of the study is adequate for the different tests used for alpha= 0.01, power= 0.80 and effect size.

As a range of statistical tests was used, a medium effect size was assumed for all tests, both bivariate and multivariate, on the assumption that, in agreement with Cohen (1992), a small effect size would be of little or no interest and that a large effect size would be unlikely. There were no previous data to guide a power analysis.

Figure 6.1. Variables and directions of the statistical analysis



6.4. PATH ANALYSIS

Subsequently to the bivariate inferential analysis, multivariate analysis has been considered to assess the simultaneous relationship among variables. Path analysis as an extension of the regression model was conducted. "Path analysis entails the use of multiple regression in relation to explicitly formulated causal models" (Bryman and Cramer 2005, p. 313).

A hypothesised model is constructed based on statistical results or a theoretical approach. The model is represented in a path diagram that makes explicit the likely connections between variables. The observed variables are linked by causal paths represented by causal arrows. As Loehlin (2004) notes, cause is understood in general terms; "the essential feature for the use of a causal arrow in a path diagram is the assumption that a change in the variable at the tail of the arrow will result in a change in the variable at the head of the arrow" (Loehlin 2004, p. 4). Arrows from outside towards dependent variables represent the influence that other variables not included in the path analysis can have in the model (Bryman and Cramer 2005). Loehlin (2004) calls them residual arrows and points out that they should be included unless it is assumed that all the causes are included in the diagram.

"The aim of path analysis is to provide quantitative estimates of the causal connections between sets of variables" (Bryman and Cramer 2005, p. 314). A straightforward approach to perform a path analysis is using multiple regression (Cramer, 2003). Estimates, called path coefficients, are numerical values that indicate the relative strength of the causal influence and are standardised regression coefficients. In order to calculate path coefficients, structural equations are defined to "stipulate the structure of hypothesised relationships in a model" (Bryman and

Cramer 2005, p. 315). Equations are analysed by multiple linear regression analysis and the standardised regression coefficients are the path coefficients. The unexplained variance for the dependent variables is calculated by taking out the R^2 of the regression model from 1.

This approach to path analysis does not provide an index of fit of a model, but R^2 gives a measure of how well the model is likely to fit in the population. Values higher than 0.3 can be considered as moderate and strong fit (Muijs, 2004).

Nominal variables need to be represented quantitatively before being included in the analysis. There are different coding systems to transform a nominal variable in code variables where "each code variable represents a different aspect of the nominal variable" and "taken together, the set of code variables represents the full information available in the original categories" (Cohen et al, 2003). One of the most widely used methods is to create dummy variables. In this method, one group is designed as a reference group, with a 0 value in all the dummy-coded variables, and the rest of the groups have a 1 value in the dummy-code variable that will contrast it with the reference group in the regression analysis (Cohen et al, 2003). "Following this coding convention, we construct a set of dummy variables for a given categorisation so that any particular respondent is coded 1 on one and only one dummy variable in the set" (Hardy, 1993).

7. METHOD FOR ANALYSIS OF OPEN-ENDED QUESTIONS

7. METHOD FOR ANALYSIS OF OPEN-ENDED QUESTIONS

Analysis of open-ended questions was carried out to identify major themes and frequency of responses. Responses were identified with the unit context variables to allow a cross-case analysis of qualitative data, looking not at generalization of data but "to see processes and outcomes across many cases, to understand how well they are qualified by local conditions, and thus to develop a more sophisticated description and more powerful explanations" (Miles and Huberman 1994, p.172). In the present case, cross-case analysis, clustering data within context variables, facilitates observing possible configurations of CMO.

Results from open-ended questions provide a further understanding of quantitative analysis. Integration of quantitative and qualitative results helps to illuminate and give guidance to the interpretation of statistical results, but also qualitative results help to clarify important concepts (Polit and Hungler 1993).

Content analysis has been used to analyse open-ended questions and the method has been developed from those described in the content analysis literature.

Krippendorff (2004), looking at the content analysis literature, identifies three kinds of definition of the method; each definition implies a different approach in data analysis, moving from a more objective quantitative analysis to a qualitative analysis. The three definitions are (p.19):

1. Definitions that take content to be inherent in a text
2. Definitions that take content to be a property of the source of a text
3. Definitions that take content to emerge in the process of a researcher analysing a text relative to a particular context.

Also Cavanagh (1997), despite describing a more quantitative approach to content analysis looking at the comparison of data, recognises how this approach does not invalidate the use of content analysis as a method "to describe phenomena and understand transactions occurring in the data" (web accessed p. 7).

Polit and Hungler (1993) point out that the quantitative approach of content analysis is very rare in nursing literature. Content analysis is more widely used in nursing as a general term "to refer to the process of analysing the content of qualitative materials for recurring themes and patterns" (Polit and Hungler 1993, p. 339). Hsieh and Shannon (2005) suggest the increased recognition of the potential of content analysis in health care and therefore the increased application and popularity. They define qualitative content analysis as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns (Hsieh and Shannon 2005, p. 1278).

There are different factors that identify different approaches within qualitative content analysis. As other qualitative methods where there are no clear-cut differences and traditions and uses are often cross-boundaries (Spencer et al 2003), qualitative content analysis lacks of a clear definition and has unsolved issues (Hsieh and Shannon 2005; Graneheim and Lundman 2004).

Hsieh and Shannon (2005), after revising health studies using content analysis, identify three approaches to qualitative content analysis: conventional, directed and summative (Table 7.1).

Table 7.1. Approaches to content analysis (adapted from Hsieh and Shannon 2005)

Type of content analysis	Study starts with	Timing of defining codes	Sources of codes
Conventional	Observation	During data analysis	Derived from data
Directed	Theory	Before and during data analysis	Derived from theory or relevant research findings
Summative	Keywords	Before and during data analysis	Derived from researchers' interest or literature review

A conventional approach is used for analysis of open-ended questions where categories and themes to describe the phenomena emerge from data. The method used to manage and code data has been a cross-sectional approach with a common system of categories applied across the whole data in order to offer a systematic overview of the scope of data (Spencer et al 2003). The analysis includes also a quantitative approach as data have been quantified by counting frequency of codes; Polit and Hungler (1993) include this possibility in qualitative analysis: "Quasi-statistics involves a tabulation of frequency with which certain themes, relationships or insights are supported by the data" (p. 331).

The method described by Hickey and Kipping (1996) has been used for data management and coding. It includes eight stages that give a detailed description of how data are organised and coded, but it can be adapted to meet specific needs of a study, such as the number of researchers or the type of data. The description of the different stages ensures rigour. It provides a detailed description of how the analysis has been done, one of the strategies recommended by most authors for rigour in qualitative research: "to create an account of method and data which stands independently so that another trained researcher could analyse the same data in the

same way and come to essentially the same conclusions" (Mays and Pope 1995, p. 110). On the other hand, the different stages include factors that ensure reliability, such as two or three researchers analysing and checking codes and categories and actual coding of the text.

Taking into account the characteristics of the study and the characteristics of the data, very specific and reasonably small, the proposed adapted approached has been selected. The stages are:

Stage 1: Immersion and identification of preliminary categories

Responses to the different open-ended questions were typed together and labelled with the questionnaire number and the unit. Other labels related to the unit characteristics and nurses characteristics could be added later on as context factors for interpretation of results. I and one of the IT experts worked independently a sample of responses to become familiar with the data and suggest categories that reflect themes emerging from it.

Stage 2: Reaching consensus on categories

We discussed the categories identified and reached an agreement about the label and rationale of each category. Some issues arose in the discussion:

- Some categories could have positive or negative responses that could be interesting to identify for further interpretation. For example: in documentation processes we found negative comments such as: "In units where the length of stay is short, a lot of time is lost entering too many data"; and positive comments: "You are more precise and concrete, and also more

meticulous, because you register practically everything in a more coherent way". We decided to add a coding of positive or negative to the category.

- Some responses include more than one category. We found responses that just add the two or more categories without establishing a relationship between them, such as "work routines have changed; on the one hand it has a positive aspect because I have at hand all the information I need and, on the other hand, I think that the holistic care of patient is being neglected"; and responses that establish a relationship between the different categories such as "there is easier communication within the team because there are more data registered and they are more accessible". In the first case we decided to separate responses in smaller units containing just one category and in the second case, following Hickey and Kipping's (1996) suggestion, responses were coded as the cause category. To keep track of these explicit associations made by nurses a new code was added including both categories with a dash separation.

Once the categories already identified were agreed, we checked the actual coding of the sample responses.

Stage 3: Allocating category and detail codes

I coded all the responses allocating to each one or more categories adding where necessary a detailed code or subcategory, similar responses within a category with a lower level of abstraction.

Stage 4: Dealing with "rogue" responses

Rogue responses were put together and analysed. They were examined for common themes trying to fit them in existing categories or creating new ones if necessary.

Stage 5: Coding check

IT expert helping in the research checked the coding decision I made working on a new sample of responses, every tenth questionnaire responses (10% of responses). Discrepancies were minimal (10% of the sample responses) but they were discussed with the IT expert and consensus was reached.

Once the coding of responses was finished, associations between the categories already developed were investigated and higher level categories or themes were identified. Interpretation of results occurs at the same time as the sorting and coding process. It includes descriptive detail of themes and categories and patterns across data.

Descriptive accounts look at the meaning and perspective that nurses give to the different categories and they are illustrated by their actual words. Analytical accounts go further in the abstraction level looking at patterns whether they are explicit associations in nurses comments or associations deduced from data between categories and the different units, categories and nurses caring for different type of patients or categories and nurses from different age groups. Recurrence of themes and categories are taken into account looking at the frequency counts of responses within each category and subcategory. They do not have statistical value and are not being presented as primary findings but as a way to understand distribution across data (Spencer et al 2003).

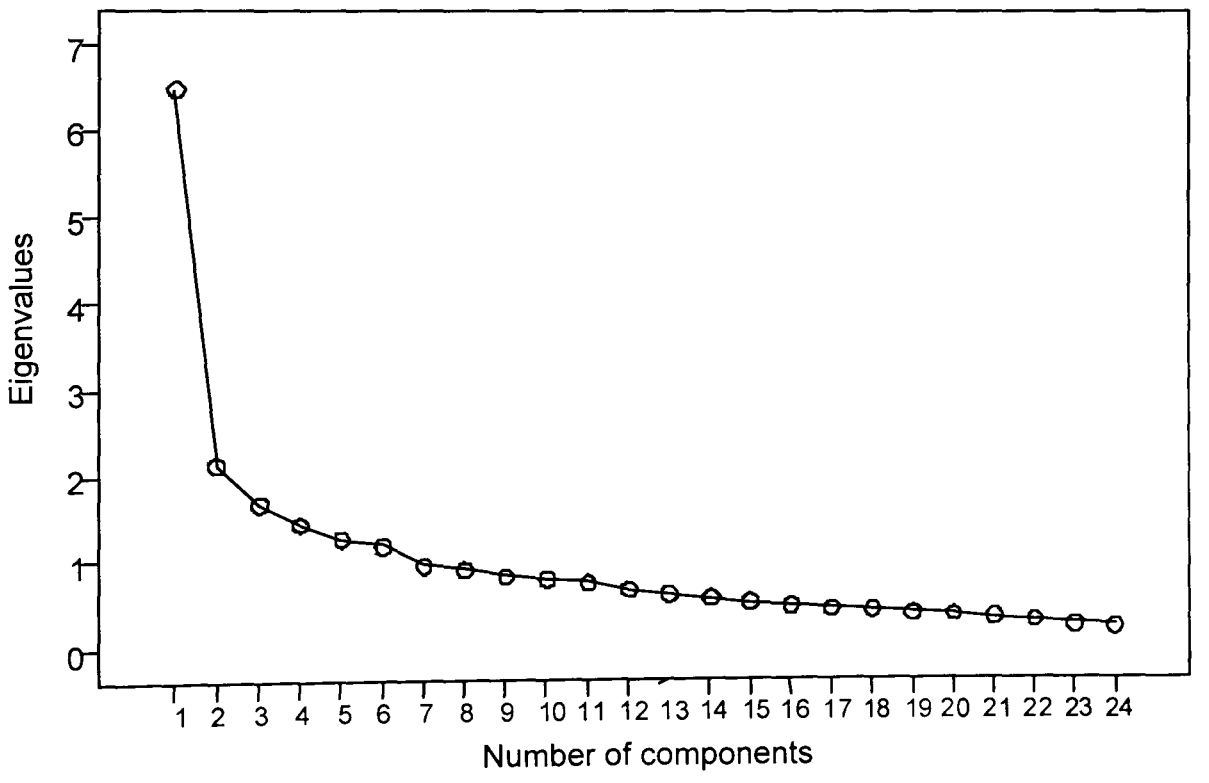
8. RESULTS OF QUANTITATIVE DATA ANALYSIS

8.1. FACTOR ANALYSIS OF MECHANISMS

Principal components factor analysis and oblique rotation were carried out using SPSS for Windows version 13.0. The initial Kaiser-Meyer-Olkin coefficient was 0.81 and the Barlett test was statistically significant (X^2= 1335.6, df= 300, $p<0.001$), therefore, carrying out factor analysis was justified. Sample size can be considered adequate as the item to subject ratio is 1:7.1.

Extraction of factors was based on a Scree plot (Figure 8.1) using visual interpretation together with interpretation of the first solution based on Eigenvalues >1 where some factors could be considered uninterpretable, having very few variables with a significant factor loading.

Figure 8.1. Scree plot of mechanisms



All items from the questions related to how the system works where initially included in the analysis (Table 8.1).

Table 8.1:Items included in the factor analysis

Question 1. Development of the program and support of users
I have received adequate training for the use of information system
The attitude of the personnel in the department of informatics is co-operative
The relationship with the personnel in the department of informatics is good
The people responsible for developing the program understand my problems
The suggestions I make are taken into account
The response time to the introduction of an improvement is adequate
The changes introduced have relevance for my daily work
Question 9. Characteristics of the running of the program
It is easy to learn how to use it
It is easy to use
It is easy to find the information you need (test results, reports, etc)
It is easy to know how to do what you need to do (request of test, record, etc.)
The program does not have unexpected interruptions
The program is quick
Question 17. Adaptation of the program to daily work of the unit
The program is integrated into daily work
The information I access from the program makes my work easier
The program improves the quality of work
I have access to information where I need it
I have access to information where I need it
The number of computers is adequate
Question 25. Characteristics of information
I find all the information I need
Information is comprehensive
Information is always updated
Data I register are important for the care of the patients
Time I use for documentation is acceptable
I am certain about the reliability of the data documented

The three latent factors identified include 17 of the initial 25 items. One item ("the number of computers is adequate") was removed because of low factor loading (0.20) and three items ("information is comprehensive", "the programme do not have unexpected interruptions" and "it is easy to find the information I need") because of cross-loading, similar communality scores in more than one factor and they did not load in a unique factor. The rest of the items removed ("program improves quality of work", "time I use for documentation is acceptable", "the programme is quick" and "I have received the adequate training for the use of information system") did not fit conceptually in the factor loaded.

The three factors explained 48.6% of the total variance. Factor 1 is described as "Usability" and includes ease of use of the program and integration of the program in daily work. It includes six items and explained 28.4% of the total variance and has an Eigenvalue of 4.83. Factor 2 is described as "IT support" and includes six items such as relationship with IT personnel, relevance of the changes introduced or nurses' problems with the program being understood by IT personnel; it explained 11.6% of the total variance and has an Eigenvalue of 1.98. Factor 3 is described as "Information characteristics" and includes both content and accessibility of information. It explained 8.52% of the total variance and has an Eigenvalue of 1.4. Table 8.2. illustrates final solution with Cronbach´s value for each factor.

Table 8.2. Principal component factor analysis followed by oblique rotation from data of mechanisms

Item label	Factors		
	1	2	3
It is easy to learn how to use it	**817**	-344	308
It is easy to use	**755**	-203	125
Data I register are important for the care of the patients	**617**	-136	360
The program is integrated in the daily work	**602**	-372	589
It is easy to know how to do what you need to do (request of test, record, etc.)	**601**	-043	305
The information I access from the program makes my work easier	**591**	-426	319
The relationship with the personnel of the department of informatics is good	-018	**-767**	211
The suggestions I make are taking into account	182	**-753**	186
The attitude of the personnel of the department of informatics is cooperative	075	**-733**	279
The response time to the introduction of an improvement is adequate	378	**-718**	194
The people responsible for developing the program understand my problems	396	**-696**	268
The changes introduced have importance for my daily work	216	**-437**	126
I have access to the information where I need it	236	-280	**777**
I have access to the information when I need it	278	-132	**766**
I am certain about the reliability of the data documented	161	-112	**678**
I find all the information I need	256	-203	**517**
Information is always updated	227	-242	**391**
Cronbach's alpha	0.77	0.79	0.66

Loadings are shown to three points after the decimal point but without the decimal point to fit the table and putative loadings are shown in bold for clarity.

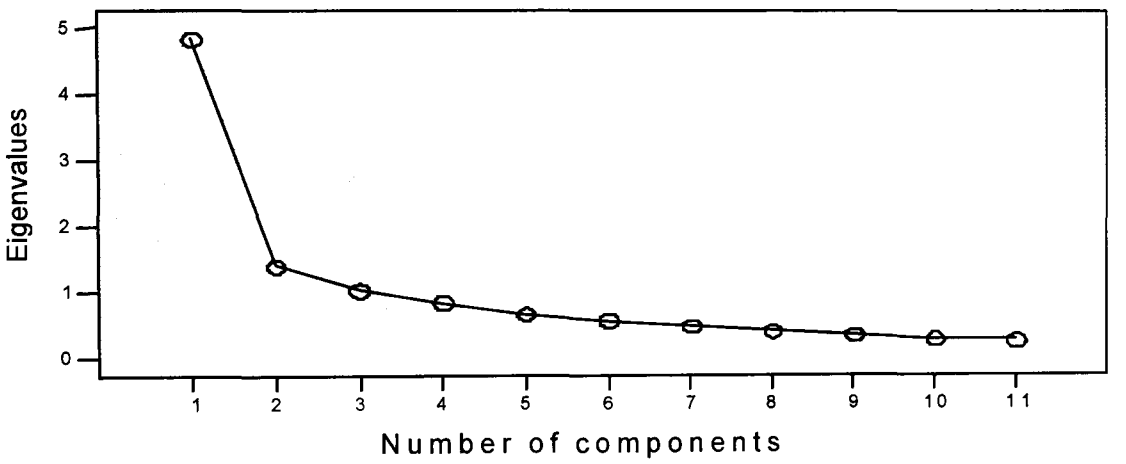
8.2. RESULTS FROM FACTOR ANALYSIS OF OUTCOMES ITEMS

For outcomes principal components factor analysis and oblique rotation was carried out. Carrying out factor analysis can be considered justified by a higher than 1:10

variable to subject ratio (1:16.2), Kaiser-Meyer-Olkin coefficient of 0.833 and the Barlett test statistically significant (X^2= 760.15, df=55, p<0.001).

Extraction of factors based on Scree plot (Figure 8.2.) visual interpretation and interpretation of the first solution based on Eigenvalues >1 gave the same number of factors.

Figure 8.2. Scree plot for outcomes items



The three latent factors identified include all the items related to outcomes in the questionnaire (question 29). The three factors explained 65.9% of the total variance. Factor 1 is described as "Impact on patient care" and includes six items and explained 43.9% of the total variance and has an Eigenvalue of 4.83. Factor 2 is described as "Impact on communication" and includes three items related to communication within the health team and the nursing team as well as recognition of nurses' work within the team. It explained 12.7% of the total variance and has an Eigenvalue of 1.39. Factor 3 is described as "Hospital profile" and includes research and image of the organisation. It explained 9.2% of the total variance and has an Eigenvalue of 1.02. Cronbach's value for each factor was calculated and range from 0.85 in the first factor to 0.64 in the third factor. Table 8.3. illustrates final solution with Cronbach's value for each factor.

Table 8.3. Principal component factor analysis followed by oblique rotation from data of outcomes

Item label	Factors		
	1	**2**	**3**
coordination of care	**808**	-237	491
facilitate patient care	**800**	-402	353
individualised care	**785**	-338	193
continuity of care	**772**	-285	357
decision-making	**761**	-402	245
quality of information	**665**	-486	263
communication nursing team	364	**-894**	166
communication health team	393	**-892**	133
consideration of nursing work	576	**-653**	238
CUN image	431	-220	**850**
research	276	-109	**847**
Cronbach's alpha	0.85	0.75	0.64

Loadings are shown to three points after the decimal point but without the decimal point to fit the table and putative loadings are shown in bold for clarity.

8.3. DESCRIPTIVE DATA ANALYSIS OF THE QUESTIONNAIRE

8.3.1. Individual characteristics.

Table 8.4. Frequency distribution for age

Age	Frequency	%
< 25 years	41	23.7
26-30	44	25.4
31-35	34	19.7
36-40	23	13.3
41-45	17	9.8
46-50	10	5.8
> 51	4	2.3
Total	173	100.0

Table 8.4. illustrates the age distribution of nurses. It can be considered a relatively young population, 68.8% below 36 years, and 50% within the first two categories. The mean number of years working is 10.1 (SD 7.5). In the previous three years, 30 % had worked as part-time at some stage with a mean of 22 (SD 16.7) months and only 18% have had periods of absence higher than two months with a mean of 8.7 (SD 5.9). Continuity in work during recent years can be considered acceptable and there is no relationship between absence and working part-time, therefore they can be considered separately for further inferential analysis. Stability in the ward unit they are working is another characteristic with 74.6% of nurses with no unit changes and only 4.6% referring to frequent unit changes during the previous three years.

In relation to nurses' experience with computers, they considered their ability with computers as good with a mean of 6.5 (SD 1.39) in a scale from 1 (low) - 10 (high). Most of them have a computer at home (76.9%) and their attitude towards information technology, not just in nursing but in society, is positive for the majority (96.5%). Because of the low responses for indifferent and negative attitudes both will be classified as "negative" for analysis purposes.

Regarding their experience of the information system in the hospital, most of them have worked with the paper record (70.9%) and, therefore, have experienced the change from paper to computer. This fact will be taken into account when interpreting results because, despite the time the system is already in place, perceptions of users will be influenced by it.

8.3.2. Unit characteristics

Hospital data from the last eight months (October 2004 to May 2005) were used to classify the individual units, which have been identified in the questionnaire, into wider aspects related to the kind of unit and activity data.

Kind of unit has been conceptualised looking at:

- the type of unit: critical care units or general wards
- the type of patients: a classification of the different medical specialities of the patients admitted in each ward as medical, surgical and critical care, was carried out and the percentages of patients in each group was used to classify the units as medical (large difference for medical patients), surgical (large difference for surgical patients) and medical/surgical (equivalent percentage in medical and surgical patients). ICU units were classified as critical care (Table 8.5.).

Table 8.5. Distribution of units according to type of patients

Unit	% of medical patients	% of surgical patients	Classification
J	4.31%	95.69%	Surgical
K	51.88%	48.12%	Medical/Surgical
L	90.49%	9.51%	Medical
I	61.49%	38.51%	Medical
H	91.63%	8.37%	Medical
F	31.30%	68.70%	Surgical
G	44.65%	55.35%	Medical/Surgical
E	61.28%	38.72%	Medical
D	42.21%	57.79%	Medical/Surgical
C	96.63%	3.37%	Medical

Table 8.6 represent the distribution of nurses in the different units included in the research and within the different groups in relation to unit characteristics, both the type of unit, whether they are ICU units or general wards, and the type of patients they have.

Table 8.6. Sample distribution in relation to units' classification

	Frequency	Percentage
Individual units		
J (surgical)	20	11.6%
K (medical/surgical)	16	9.2%
L (medical)	10	5.8%
I (medical)	14	8.1%
H (medical)	10	5.8%
F (surgical)	10	5.8%
G (medical/surgical)	15	8.7%
E (medical)	9	5.2%
D (medical/surgical)	18	10.4%
C (medical)	15	8.7%
A (ICU)	26	15.0%
B (ICU)	10	5.8%
Type of unit		
General ward	137	79.2%
ICU	36	20.8%
Type of patients		
Surgical	30	17.3%
Medical	58	33.5%
Medical/surgical	49	28.3%
Critical care	36	20.8%

Activity data were calculated only for general wards and they include: mean number of patients, occupancy rate, intensity of patients (mean DRG weight of all patients admitted) and variability of patients (daily mean number of different specialities).

General wards have a mean number of patients of 21.67 (SD 6.87) and the occupancy rate is high with a mean percentage of 86.14% (SD 6.67). Summary of results from the different units can be observed in Table 8.7.

Table 8.7. Activity results for the different units (all the results come from hospital data from October 2004 to May 2005)

Unit	Mean number of patients	Occupancy rate (%)	Intensity of patients*	Variability**
J	24.44	94.0	1.43	5.94
K	10.92	78.0	1.28	6.51
L	12.08	80.5	1.64	5.69
I	28.85	93.1	2.72	9.77
H	13.78	86.1	1.62	6.11
F	19.67	98.4	1.64	6.91
G	28.83	80.1	1.78	10.43
E	26.26	84.7	1.38	9.64
D	28.75	79.9	2.18	10.38
C	17.59	88.0	2.98	5.93

* Mean DRG weight of all the patients admitted in the unit
** Daily mean of the number of different specialities in the unit

8.3.3. Mechanisms

Results from the descriptive analysis in relation to mechanisms have been grouped in four main areas: support, ability with the program, usability and information characteristics.

Information technology department support

Support from the information systems department, calculated as the mean of the summed scores of items included in the factor, is positively perceived by nurses,

mean= 1.82 (SD 0.49) in a Likert scale from 1 (strongly agree) - 5 (strongly disagree). Table 8.8. represents the mean values for the different items included in the factor.

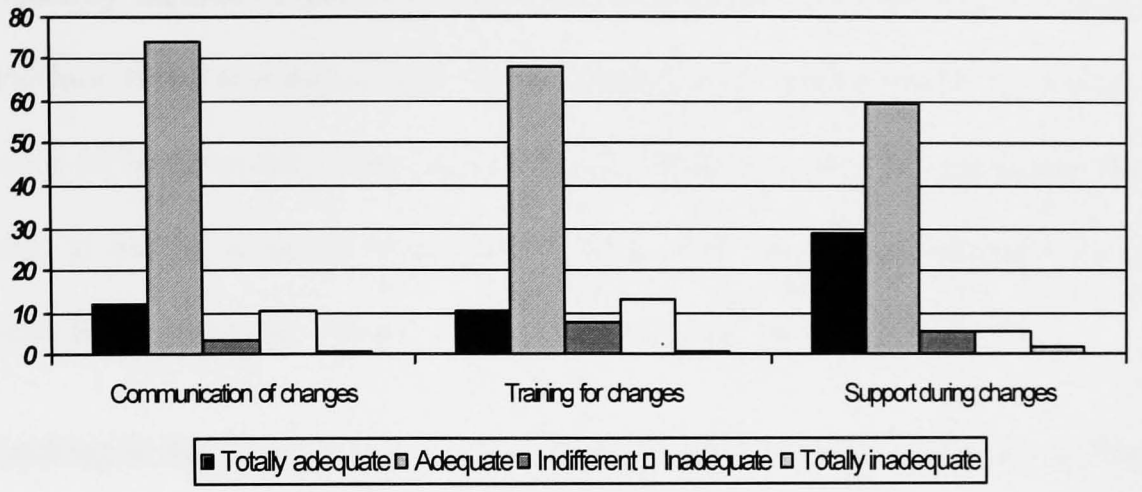
Table 8.8. Mean and standard deviation for items related to information technology support

Items	Mean	SD
The attitude of the personnel of the department of informatics is cooperative	1.54	0.61
The changes introduced have importance for my daily work	1.59	0.54
The relationship with the personnel of the department of informatics is good	1.65	0.61
The people responsible for developing the program understand my problems	1.88	0.78
The suggestions I make are taken into account	2.00	0.77
The response time to the introduction of an improvement is adequate	2.27	0.86

All the items are positively valued taking into account that none of them have a mean higher than 3.00 that could be understood as the boundary between positive and negative values. The attitude of the IT personnel is the most positive aspect, mean= 1.54; SD= 0.61. Although highly valuing the relevance of the changes introduced for their daily work (mean=1.59; SD=0.54), nurses perceived less strongly, but still positively, that IT personnel consider their suggestions (mean= 2.00; SD=0.86) and their needs (mean=1.88; SD=0.86) when improving and developing the program. The response time is the least valued aspect (mean=2.27; SD=0.86).

In relation to support during changes introduced in the system, nurses consider communication, training and support during implementation adequate (Figure 8.3).

Figure 8.3. Percentage of categories for support with changes in the program



Training appears to be an identified need, it is not only valued as inadequate for 15% of nurses during changes, but also when asked in general if they need more training for an adequate use of the system, 52% responded positively.

Ability with the program

Nurses were asked to rank their ability with the program on a scale from 1 (low) - 10 (high), the mean value was 7.45 (SD 1.06). Nurses consequently feel confident in the use of the program but when asked about the frequency of problems they experienced using it, more than 50% still have problems several times a week or once a week and only 19.1% have them less than once a month. Analysis of open questions will clarify if these problems are more related to problems within the system and not to problems of users.

Related to frequency of problems is the fact that, with the most common problems they have, 75.5% of nurses go to colleagues as the most frequent resource for help.

Usability

Usability includes aspects related to the easy-to-use characteristics of the program and how it is integrated in daily work. Usability as a general factor is analysed as the mean of the summed scores of items included in the factor. Nurses agreed that it is easy to use the program in their daily work. The mean value obtained in a Likert scale from 1 (strongly agree) - 5 (strongly disagree) was 1.74 (SD 0.47).

Looking at the items included in the factor (Table 8.9) it is interesting to note how integration and usability of the program in their work is valued more positively (lower values) than the ease of use of the system.

Table 8.9. Mean and standard deviation for items related to usability of the program

Items	Mean	SD.
The program is integrated in the daily work	1.50	0.59
Data I register are important for the care of the patients	1.52	0.65
The information I access from the program makes my work easier	1.74	0.73
It is easy to use	1.80	0.70
It is easy to learn how to use it	1.83	0.72
It is easy to know how to do what you need to do (request of test, record, etc.)	2.06	0.72

Some contradiction can be found when nurses respond separately to whether the program makes their work easier or not and more or less stressful; 90.4% think that the program makes their work easier but 58.1% affirm that it makes their work more stressful; 81.5% of the nurses who have experienced the change from paper to

computer system affirm that the introduction of the computer system has brought changes in the unit routine.

Information characteristics

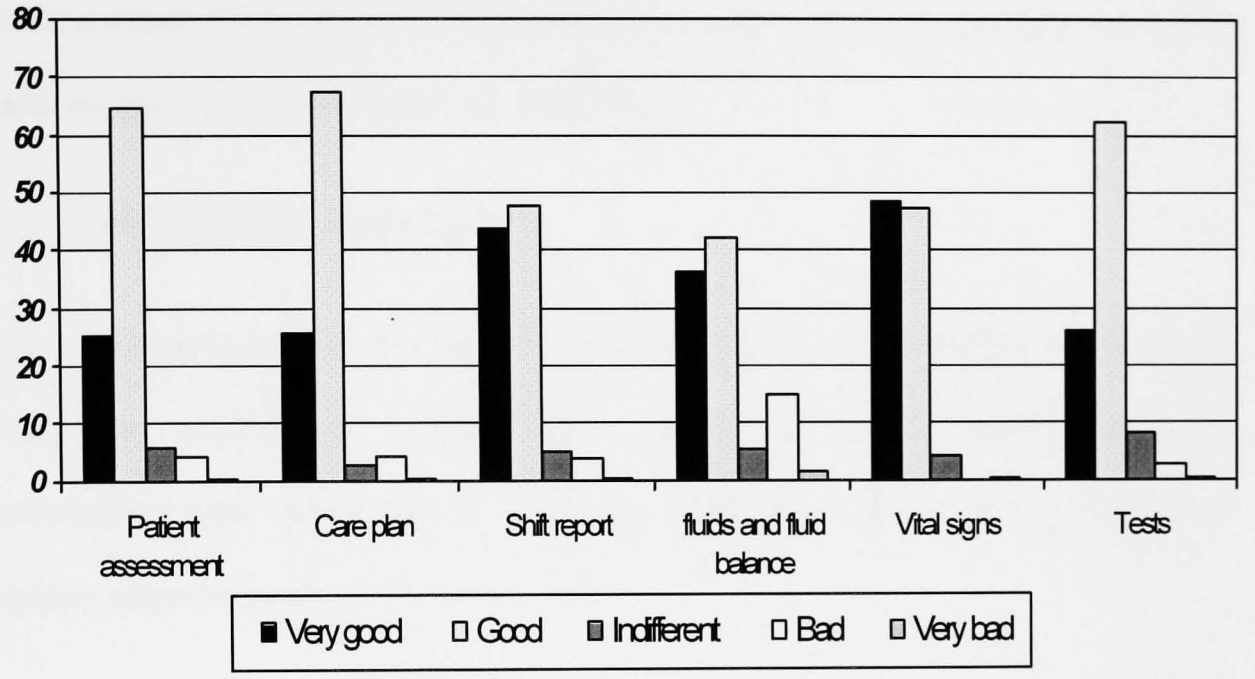
This area encompasses not just quality of the content but also aspects related to accessibility of data and information. Information characteristics has a mean value of 2.1 (SD 0.5) in a Likert scale from 1 (strongly agree) - 5 (strongly disagree). Still being positive, it is the least valued factor compared with the rest of the areas (Table 8.10).

Table 8.10. Mean and standard deviation for the factors included in the mechanisms

Items	Mean	SD
Usability	1.74	0.47
IT support	1.82	0.49
Information characteristics	2.10	0.56

The satisfaction with the quality of the information of the nursing record is high and it is summarised in Figure 8.4.

Figure 8.4. Percentage within the categories to evaluate quality of the nursing documentation



Contradictory results appear again. Satisfaction with the content of the documentation is high but the information that the computer program provides does not give a complete picture of the situation of the patient for 54.1% of the nurses.

8.3.4. Outcomes

Nurses are satisfied with the program with a mean value of 7.37 (SD 1.13) in a scale from 1 (low) - 10 (high). Outcomes in relation to the impact of the program in aspects related to their job are also positively valued with a mean of 2.05 (SD 0.46) for general outcomes in a Likert scale from 1 (very positive) - 5 (very negative). Impact on hospital profile, that is in the use of the program for research and in the image of the hospital, is the most positively valued (mean=1.88; SD= 0.63), followed by impact of patient care (mean=2.05; SD= 0.51) and teamwork (mean= 2.18; SD= 0.62).

When asked the key question for satisfaction: if they would go back to paper records or reintroduce paper records, 79.8% responded 'no' and only 7.5% wanted to go back to paper. From the 12.7% of nurses who 'do not know' most of them are nurses with no experience of the paper record system.

8.4. INFERENTIAL ANALYSIS

As a general rule, the way the IT system works has to produce the expected outcomes; mechanisms and outcomes should be closely related. Bivariate correlations were carried out to verify the relationship between the mechanisms, system characteristics and the outcomes.

Highly significant results were drawn for all the variables except for ability with computers that had no significant correlation values for patient care and hospital profile. (Table 8.11). There is a close relationship between mechanisms and outcomes and therefore outcomes can be considered as explained by mechanisms.

Table 8.11. Pearson's correlation coefficients for mechanisms and outcomes

	Satisfaction with the program	Patient care	Teamwork	Hospital profile	Global outcomes
IT support	-0.419**	0.365**	0.419**	0.254**	0.436**
Usability	-0.537**	0.498**	0.521**	0.321**	0.576**
Information characteristics	-0.470**	0.511**	0.458**	0.284**	0.558**
Quality documentation	-0.406**	0.489**	0.340**	0.276**	0.491**
Ability with the program	0.426**	-0.150	-0.266**	-0.111	-0.212**

** $p < 0.01$

Before carrying out the analysis a comparison of individual characteristics within units' classification was performed to ensure that there were no individual characteristics differences within the different unit variables and, therefore, both, individual users' and units' characteristics can be analysed separately without risk of bias.

No individual differences were found within the different unit classifications (individual units, type of unit and type of patients) except for years working; nurses working in ICU are older than those working in general wards (t= 2.708, df= 170, p=0.007). Therefore, individual users' and units' characteristics can be analysed separately without risk of bias. Tests used for analysis and results are summarised in Table 8.12; significant results appear in bold.

Table 8.12. Comparison of nurses' characteristics within the different units' classifications

CONTEXT INDIVIDUAL USERS (dependent variable)	**UNIT CLASSIFICATION**		
	Individual units	Type of unit	Type of patient
age	0.117[a]	0.077[b]	0.151[a]
years working	**0.013[c] ***	**0.007[d+]****	**0.020[c#]***
overall time of absence	0.130[c]	0.401[d]	0.070[c]
time as part time	0.312[c]	0.558[d]	0.120[c]
attitude towards introduction of technology	0.547[e]	0.582[e]	0.415[e]
ability with computers	0.580[a]	0.129[b]	0.136[a]

[a] Kruskal-Wallis; [b] Mann-Whitney; [c] ANOVA; [d] t-test; [e] Chi-square; ** p< 0.01
* p< 0.05;
[+] t= 2.708; degrees of freedom= 170
[#] F= 3.308; degrees of freedom= 3

8.4.1. Relationships between nurses' characteristics and mechanisms and outcomes

Results from comparison between mechanisms and nurses' characteristics did not produce significant results except for ability with the program that is highly significant for most of the nurses' characteristics variables. Comparison within age categories are significant (X^2=26.241, df= 6, p<0.001); mean value for ability with the program tends to be more positive in younger nurses (Table 8.13). In the same way years working and ability with the program have a negative correlation (r= -0.238, p<0.001), the more experience the less ability. As it is expected nurses considering themselves as good in computer use feel confident in the use of the program (r= 0.524, p<0.001).

Table 8.13. Mean values of ability with the program in relation to age

	n	Mean	SD
< 25 years	41	7.54	0.94
26-30	44	7.87	0.70
31-35	33	7.6	1.09
36-40	22	6.86	1.28
41-45	17	6.97	1.28
46-50	9	6.66	0.70
> 51 years	4	7.75	0.95
Total	170	7.45	1.06

Attitude towards introduction of information technology is the only users' characteristics that have significant results on some mechanisms (Table 8.14): usability (t= 2.988, df=167, p=0.003) and quality of documentation (t= 3.495, df= 164, p=0.001).

Table 8.14. Mean scores of mechanisms in relation to attitude towards the introduction of information technology and t-tests for each of the mechanism

	Negative			Positive			t-test	
	n	Mean	SD	n	Mean	SD	df	t
IT support	5	2.26	0.72	163	1.80	0.48	166	2.048*
Usability	6	2.30	0.66	163	1.72	0.45	167	2.988**
Information characteristics	6	2.58	0.71	163	2.09	0.55	167	2.108*
Quality documentation	5	2.56	0.64	161	1.80	0.47	164	3.495**

** $p< 0.01$; * $p< 0.05$; SD: standard deviation

Nurses with a positive attitude have lower mean values and, therefore, more positive perception of all the mechanisms variables, especially for usability and quality of documentation.

Attitudes towards introduction of technology is also the only user characteristic with significant results on outcomes, both for satisfaction with the program ($Z= -3.085$, $p=0.002$) and all the factors included in the outcome analysis (patient care, teamwork, hospital profile and general outcomes). It is highly significant for all variables except for hospital profile where significance is only $p< 0.05$. Nurses with a positive attitude towards the introduction of technology have a better perception of the impact of electronic system in their daily work (Table 8.15)

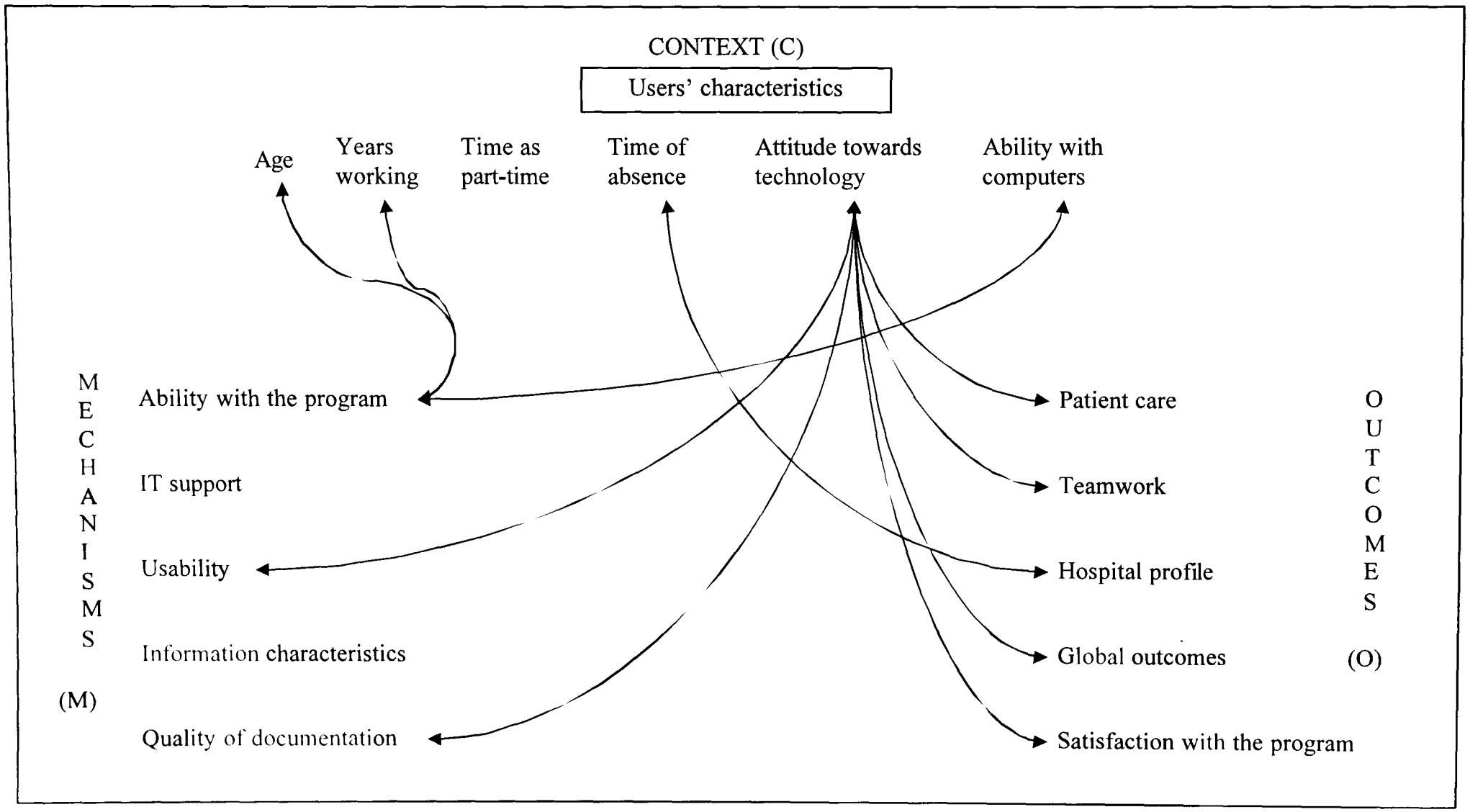
Table 8.15. Mean scores of outcomes in relation to attitude towards the introduction of information technology and t-tests for each of the outcomes

	positive			negative			t-test	
	N	Mean	SD	n	Mean	SD	df	t
patient care	161	2.02	0.48	6	2.83	0.84	165	3.926**
team work	164	2.15	0.58	6	3.11	0.80	168	3.868**
Hospital profile	165	1.86	0.61	6	2.41	1.02	169	2.125*
global outcomes	158	2.02	0.42	6	2.83	0.78	162	4.452**

** $p < 0.01$; * $p < 0.05$; SD: standard deviation

Figure 8.5 summarises results of the analysis of CMO looking at users' characteristics as context. Lines represent comparisons and relationships with significant values $p < 0.01$.

Figure 8.5. Representation of the significant relationships between users' characteristics, mechanisms and outcomes



8.4.2. Relationships between units' characteristics and mechanisms and outcomes

Support from the information technology department is the mechanism most related to unit characteristics. Mean values of IT support are more negatively perceived in ICU than general ward ($t= 4.770$, $df= 167$, $p<0.001$). On the basis of individual units, ANOVA demonstrated significant differences ($F= 4.717$, $df= 11$, $p<0.001$). Bonferroni testing (Appendix 6) showed that this difference lay only between ICU and most non-ICU units. Testing on the basis of type of patient ANOVA showed significant differences ($F= 7.990$, $df= 3$, $p<0.001$); Bonferroni testing (Appendix 7) showed difference between ICU and other types of patient. Therefore the difference in support from IT on the basis of unit characteristics seems mainly to counted to by differences between ICU and other areas.

Similar results can be observed for information characteristics, although significance when comparing within individual units is only $p< 0.05$.

What is interesting to note is that context variables more related to workload, such as occupancy rate and intensity of patients, have no influence in assessment of mechanisms (Table 8.16)

Table 8.16. Pearson's correlation coefficients for mechanisms and nursing units activity variables

	Ability with the program	IT support	Usability	Information characteristics	Quality of documentation
Mean number of patients	0.033	0.099	0.046	-0.036	-0.025
Intensity patients (DRG)	0.002	-0.004	0.043	0.105	-0.046
Occupancy rate	0.137	-0.081	-0.061	-0.049	-0.187*
Mean number of specialities	-0.074	0.155	0.057	-0.068	0.085

* $p < 0.05$

As with mechanisms, unit characteristics seem to have more influence than users' characteristics on outcomes, but results point out that differences are explained not just by the distinction between general wards and ICU and therefore type of patients and individual units have also some impact on outcomes. Differences between general wards and ICU are only highly significant for teamwork ($t = 3.792$, $df = 169$, $p<0.001$). Type of patients has significant differences in patient care ($F = 4.676$, $df = 3$, $p=0.004$), teamwork ($F = 7.987$, $df = 3$, $p<0.001$) and mean score for outcomes ($F = 6.018$, $df = 3$, $p=0.001$).

Table 8.17. Mean scores of outcomes for the different type of patients and ANOVA scores for each of the outcomes

	Surgical		Medical		Medical/surgical		Critical care		ANOVA	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	df	F
patient care	30	2.03 (0.41)	58	1.86 (0.43)	47	2.21 (0.61)	33	2.15 (0.49)	(3, 164)	4.676**
team work	30	1.94 (0.43)	58	2.00 (0.56)	47	2.29 (0.64)	36	2.51 (0.64)	(3, 167)	7.987**
Hospital profile	30	1.83 (0.56)	57	1.82 (0.62)	49	1.94 (0.77)	36	1.91 (0.50)	(3, 168)	0.428
general outcomes	30	1.97 (0.32)	57	1.88 (0.40)	45	2.20 (0.55)	33	2.20 (0.40)	(3, 161)	6.018**

** $p < 0.01$

As can be seen in Table 8.17, units caring for medical patients have a more positive perception on outcomes than those caring for medical/surgical patients and critical care patients. Differences in patient care are explained by differences between medical and medical/surgical; medical units being the ones that perceived a positive impact of information technology in patient care. Teamwork differences, as have been seen in the comparison between ICU and general wards, are explained by the negative perception of ICU nurses when compared to the rest of units.

Comparisons for individual units have also significant values for patient care ($F= 2.646$, $df= 11$, $p=0.004$), teamwork ($F= 3.115$, $df= 11$, $p=0.001$) and mean score for outcomes ($F= 3.083$, $df= 11$, $p=0.001$).

It is interesting to note that one unit (unit D) showing more significant values in the Bonferroni post-hoc test, is not a medical unit. Therefore, other aspects of unit characteristics, more than just the simple distinction between UCI and general wards or the type of patients, are affecting the perception of outcomes except for teamwork.

Unit characteristics in relation to workload have less impact although some significant values ($p< 0.05$) can be found (Table 8.18). It is interesting that the negative correlation between the number of specialities, a reference for the diversity of patients in the unit, and satisfaction with the program, show the more specialities involved the less satisfaction with the program. On the other hand occupancy rate has a significant positive correlation; more busy units are more satisfied with IT.

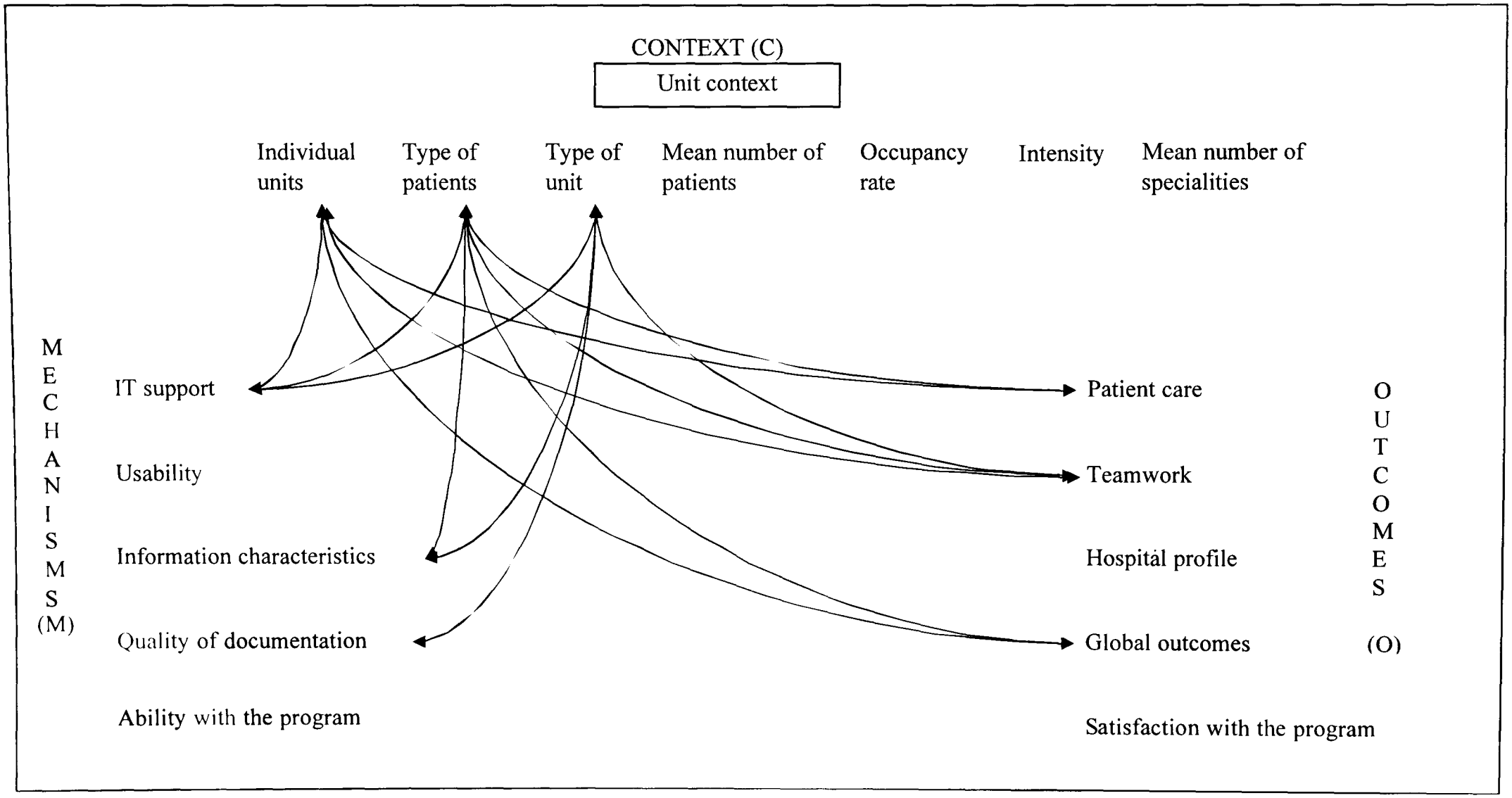
Table 8.18. Pearson's correlation coefficients for outcomes and nursing units activity variables

	Satisfaction with the program	Patient care	Teamwork	Hospital profile	General outcomes
Mean number of patients	-0.126	0.109	0.064	0.019	0.094
Intensity patients (DRG)	-0.067	0.012	0.063	0.104	0.050
Mean number of specialities	-0.199*	0.171*	0.138	0.028	0.164
Occupancy rate	0.205*	-0.084	-0.210*	-0.026	-0.144

* $p < 0.05$

Figure 8.6 summarises results of the analysis of CMO looking at units' characteristics as context. Lines represent comparisons and relationships with significant values $p < 0.01$.

Figure 8.6. Representation of the significant relationships between units' characteristics, mechanisms and outcomes



8.4.3. Results from path analysis

Context variables included in the path analysis are those with significant results in the bivariate analysis. To simplify the analysis a mean value (IT environment) for the factors included in mechanisms (IT support, usability and information characteristics) has been used; ability with the program has been considered separately because of the theoretically developed causal paths in the model. Also, outcomes variables have been comprised in one item calculating a mean value for the outcomes factors and satisfaction with the program. Despite differences in the measure of the variables, a high correlation among them justifies the calculation of a mean value of all of them. Satisfaction with the program variable was recoded in order to have the same direction from positive to negative values as the outcomes scores.

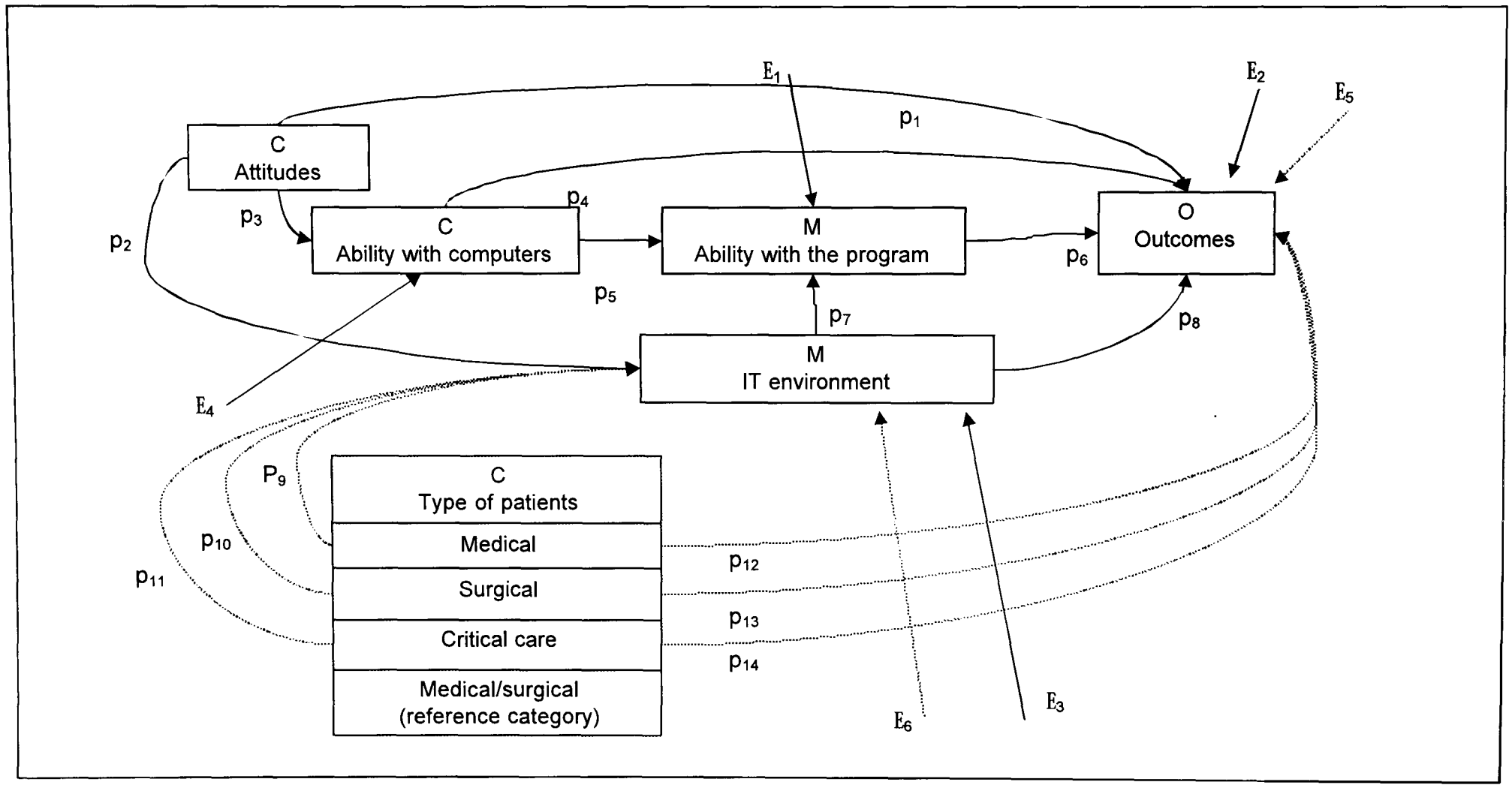
A hypothesised model was constructed based on significant relationships from the bivariate analysis and following the CMO configuration pattern. In order to provide a better understanding of the impact of context variables on mechanisms and outcomes, the analysis has been done initially for individual context variables (attitudes towards the introduction of technology and ability with computers) and in the second step unit variables have been included. Unit variables with a significant relationship in bivariate analysis are type of unit and type of patients, but only type of patients has been included in the analysis as it already includes a category for critical care patients. Type of patients needs to be transformed into dummy-coded variables before being included in the analysis. Medical/surgical patients have been considered the reference category as it is the least specific category, having both

medical and surgical patients. The dummy-coded variables are represented in table 8.19. The models are represented in a path diagram (Figure 8.7).

Table 8.19. Dummy-coded variables for type of patients

Type of patients	Value	Dummy: Surgical	Dummy: Medical	Dummy: Critical care
Surgical	1	1	0	0
Medical	2	0	1	0
Medical/surgical (reference category)	3	0	0	0
Critical care	4	0	0	1

Figure 8.7. Path diagram for significant relationships between context, mechanisms and outcomes variables



——— Model A: individual context variables

.. Model B: individual and unit context variables

C: context variables; M: mechanism variables; O: outcomes variables; p: causal paths; E: unexplained variance (1- R^2)

The structural equations designed for the analysis of model A are:

- Ability with computers = (B) attitudes + E_4
- IT environment = (B) attitudes + E_3
- Ability with the program = (B) attitudes + (B) ability with computers + (B) IT environment + E_1
- Outcomes = (B) attitudes + (B) ability with computers + (B) ability with the program + (B) IT environment + E_2

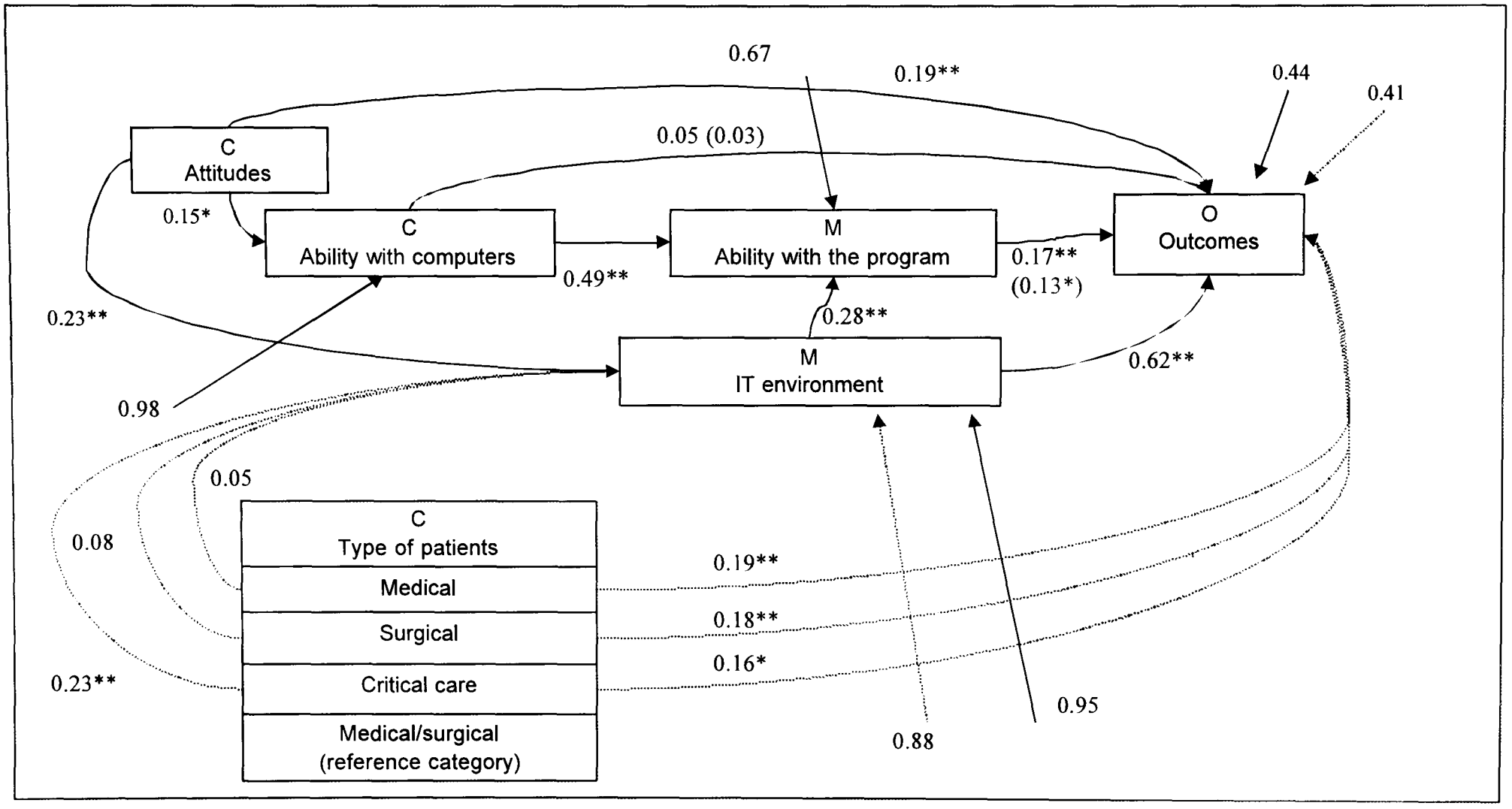
(B corresponds to the path coefficient and E to the unexplained variance)

Model B:

- Ability with computers = (B) attitudes + E_4
- IT environment = (B) attitudes + (B) Medical + (B) Surgical + (B) Critical care + E_6
- Ability with the program = (B) attitudes + (B) ability with computers + (B) IT environment + E_1
- Outcomes = (B) attitudes + (B) ability with computers + (B) ability with the program + (B) IT environment + (B) Medical + (B) Surgical + (B) Critical care + E_5

Multiple linear regression analysis has been carried out for each of the equations. The significance level of $p< 0.05$ was used for the standardised beta regression coefficients and for the adjusted R^2 which indicates the explained the amount of explained variance for each of the dependent variables. Results are represented in Figure 8.8.

Figure 8.8. Path analysis of significant relationships between context, mechanisms and outcomes



*p= 0.05; ** p= 0.01; Numbers in parenthesis: path coefficients changes in model B (------)

There is a significant impact of both mechanisms and context variables on outcomes. In model A, only with nurses characteristics variables, the total unexplained variance for outcomes as a dependent variable is E= 0.44. When unit characteristics are included, model B, it does not make a big difference, E= 0.41.

The biggest influence is made by IT environment (B= 0.62, p< 0.01). In the same way, when IT environment is taken out from the model the unexplained variance increases significantly (E= 0.70) if compared with the unexplained variance resulted from taken out attitudes (E= 0.45).

Attitudes have both a direct effect on outcomes (B= 0.19, p= 0.001) and an indirect effect through IT environment (B= 0.23, p= 0.002). Ability with computers has only an indirect effect on outcomes through ability with the program (B= 0.49, p< 0.01).

Unit characteristics have only a direct effect on outcomes and they do not have a significant influence on mechanisms, except for critical care patients.

It is interesting to note that some differences can be found when the path diagram is applied separately for satisfaction with the program (Appendix 8) and outcome factors (Appendix 9). The total unexplained variance increases in both cases, to E= 0.55 in model A and E= 0.55 in model B for satisfaction, and to E= 0.53 in model A and E= 0.49 in model B for outcome factors.

Although still being highly significant, changes in the influence made by IT environment can be observed. Satisfaction is less influenced by the IT environment (B= 0.48, p< 0.01) than outcome factors (B= 0.63, p< 0.01). On the other hand, unit characteristics do not have a direct effect on satisfaction but it has a direct effect on

outcome factors. Lastly, ability with the program has a direct effect on satisfaction ($B= 0.27$, $p< 0.01$) but not on outcome factors.

9. RESULTS OF ANALYSIS OF OPEN-ENDED QUESTIONS

9. RESULTS OF ANALYSIS OPEN-ENDED QUESTIONS

The questionnaire includes open-ended questions; some of them are direct open questions while others ask for further explanations in a response to a closed question. One of the open questions was not included in this analysis because, when analysed, it was discovered that not all the nurses understood it in the same way, so producing conflicting results.

Six main themes, which comprise different categories, emerge from the content analysis of the results of open-ended questions. There were categories that have not been included in the final results because their contribution to the overall description was minimal, either because they were mentioned very rarely (less than 5% of the coded responses) or because of the lack of richness of content. Table 9.1 summarises the different themes and categories.

Table 9.1. Themes and categories from open-ended questions

THEME	CATEGORIES
Information: data and information provided by the program	1. Information accessibility 2. Quality of the information content 3. Quality of the information format
Communication: impact of the use of the program in communication processes	1. Communication in the nursing team 2. Communication in the health team
Patient care: impact of the use of the program in patient care	1. Continuity of care 2. Co-ordination of care 3. Decision-making 4. Individualised care 5. Patient care in general
Documentation process: impact of the program in the documentation process	1. Quality of the documentation process
Work dynamics: impact of the use of the program in the work routine	1. Makes work easier 2. Integration of IT in daily work
Running of the program: how the program works	1. Unexpected interruptions 2. Speed of the program 3. Ease of use

An overview of the findings is given by the overall description of the different main themes taking into account the association of themes and categories within the different questions. Cross-case analysis was carried out looking at associations across the different type of units in relation to the kind of patients and nurses in relation to age. An overview of themes can guide the interpretation of the separate groups as it provides the structure to compare and contrast different groups.

The frequencies of responses help to further understand the findings and nurses' responses are used to illustrate the descriptions; quotes are identified by the questionnaire number in parentheses. I translated nurses' responses.

9.1. OVERALL DESCRIPTION OF THE THEMES

9.1.1. Information

Information represents the highest frequency of coded responses, that being mainly positive, and relates to the advantages of the IT system and how an information system contributes to good documentation. It comprises three categories (Table 9.1).

Accessibility of data is mostly positive with only three responses categorised as negative. To describe accessibility nurses talk about finding information quickly, easy access to a large amount of data and access to the same data from different places within the hospital.

> "An information system gathers all the documentation, it is always available and it can be accessed by all the members of the health team from different places" (q.97).

Nurses reflect the positive impact that accessibility of data, anywhere and any time, has in daily practice.

They do not mention confidentiality issues associated with the accessibility of data:

they recognise that the system has security measures to protect patient data and to secure access and use by professionals, but they are not always well used.

Quality of information content is generally expressed as "a lot of data" or "all the patient data". Nurses trust that everything is recorded and that the patient record in the IT system is as complete as possible. Along with more data being registered, nurses identify as factors contributing to this completeness of data that with the IT system there is a lower risk of losing patient data and that errors due to transcription or misreading are minimised. The need to enter the data to contribute to the quality of the content is acknowledged by some of the nurses; one of them says:

> "The computer tells you what you have registered, but the computer does not know what you do not register" (q.88).

Nurses consistently identify the quality of information format as the program providing a "global view of the patient"; clarity, classification and organisation of records are some of the characteristics described by the nurses. Nevertheless, nurses recognise the importance of other nurses' information in order to have a complete and comprehensive picture of the patient situation and the need to see the patient in order to make sense of the information they get from the system. One nurse says:

> "The program gives you specific data about the patient, but it is only by seeing and being with the patient that enables you to understand the real situation" (q.111).

Despite the introduction of the IT system, there still a primacy of oral communication in relation to the shift report, they use the IT system information to confirm or check what has been said.

An important aspect which contributes to the quality of both the content and the format of the information, is that the system is an integrated system that unifies all patient data. Nevertheless, one nurse questions herself about confidence in the quality and accuracy of data provided by the system where there are so many different people using computers to access and enter data.

Negative responses are mainly associated with the problem of having two different programs for nursing documentation that makes the continuity of the patient documentation and access to the data registered in the other program difficult. Nurses also feel that there are aspects of the patient that do not fit into the more structured data used in the system.

9.1.2. Documentation process

Coded responses of the quality of the documentation processes are present in all questions except on those related to results or outcomes. Nurses consistently identify that the use of the program has a positive influence on the documentation process.

Nurses recognise that the system provides a unified way to collect data from all the professionals. Additionally, they report satisfaction using the program for recording patient data and recognise that it is easier to document data with the IT system than to do it with the paper record. One nurse refers to this saying:

> "You are more precise and more specific, and also more meticulous, because you register practically everything but in a more coherent way" (q.67).

The IT system provides protocols which help nurses to plan the care and assessment of the patient; they identify the use of protocols as being more difficult to forget

things that need to be documented and contributing to a more unified way of working across the hospital.

An important aspect raised by nurses about the introduction of the IT system is the increased awareness of the importance of the documentation processes. Documentation is now more considered as part of their responsibility and it is increasingly integrated into their daily work.

> "Now you dedicate more time to patient documentation but because now we are assimilating that patient documentation is part of our work. Before you did it only if you had spare time" (q.109).

Many of the less optimistic views revolved around the documentation process with the IT system being time consuming and the risk of not doing it well. The amount of data that needs to be recorded is identified as the main reason; sometimes there is no time to do it properly and sometimes, as you have to record so many data everyday, you tend to do it in a routine way.

> "You have to fill in so many data that it can begin to be monotonous and you register it out of habit" (q.9).

Negative responses also refer to the failure of more structured data used by the program to reflect what they want about the patient, nurses express it as the need to say "something" else when registering patient data. It is interesting to note how structured data are seen as positive for recording patient data but when nurses talk about searching patient data to learn about the patient, they refer to the unstructured data written in the system at the end of each shift. In the same way, under time or

workload pressure, they tend to write about the patient instead of recording the structured data.

It is interesting that nurses, after the introduction of the IT system, continue using "scraps" ("personalised recordings of information that is routinely made on any available piece of paper or in small notebooks" (Hardey et al 2000, pp208)) as the working tool during the shift for patient data. Although they reflect trying to register in the IT system during the shift, it is usually at the end of the shift when they sit down in front of the computer and complete patient documentation. Scraps are seen as a working tool but not part of patient documentation.

9.1.3. Communication

Communication is generally identified as an outcome of the use of the IT system in clinical practice. It is interesting to observe that, although there is a balance between positive and negative responses, when we look at the categories we see that communication within the nursing team is mostly negative and communication within the health team is mostly positive.

Positive responses refer to better communication of patient data because of the accessibility of information for all members of the team, having all patient data registered and in the same place. Negative responses are mainly related to the decrease of verbal communication.

With regard to describing the impact on communication in the nursing team, nurses talk about more individualised work, lack of information about other patients in the unit, more time spent on computer and therefore less time to talk to nurses in the team.

> "With regard to communication within the nursing team, when it is about patients it is positive, but on direct contact with nurses it has a negative influence. Nurses spend more time with the computer and talk less" (q. 45).

In relation to communication within the health team, while some nurses view accessibility of data as a positive factor for communication, others feels that, because of increased accessibility doctors are less physically present in the units and they tend to ask fewer questions of the nurses. This is seen in statements such as:

> "Before doctors came to the ward to update medical orders and incidences were discussed. Now they update medical orders from *distance* and have less presence in the ward" (q.164).

9.1.4. Patient care

After information, patient care has the highest frequency of coded responses and it is positively valued. Although it comprises five categories, nurses tend to talk in general about patient care without making specific references to the different aspects of it. It is curious to note the few responses related to decision making and that those are negative. It seems to be more related to the decrease of verbal communication - decisions are not talked about - than to the increase of patient data and its accessibility.

> "At the time of the ward round and changing the treatment of the patient, now it is done practically without consulting you, before it was more teamwork" (q.133).

Responses are mostly related to results: why good documentation is needed and positive and negative results. It is interesting to note the same frequency of coded

responses of patient care within positive and negative results. It is clear that the reason for good documentation is patient care but the program itself is perceived as having a positive and a negative impact on patient care.

The program facilitates a unified way of working across the different professionals and the different units. Nurses also feel that the use of the program decreased the risk of errors thus having a positive impact on quality and safety issues:

> "Everything is recorded. The concept of *error* is dramatically decreased" (q.154).

There is a close relationship between information and patient care on nurses' comments; information is seen as the basis for individualised and high quality patient care.

Negative responses talk about the decrease in time spent with patients.

> "Sometimes I have the impression that instead of sitting at the computer I should be in the room with the patient" (q.146) or
>
> "It requires more time for the computer and that means less time for the patient" (q.70).

9.1.5. Running of the program

The running of the program seems to be the most negative aspect of the IT system and coded responses are mainly related to the problems with the program.

Unexpected interruptions is the most frequently mentioned problem because nurses have to exit the program and then enter it again and this means time and sometimes re-entering data. The speed of the program and the ease of use have a balance between positive and negative perceptions, the former being a little more negative.

9.1.6. Integration of the program in work dynamics

There is a balance of positive and negative responses. The negative responses are linked to the lack of integration of IT in daily practice, especially because of the resistance that some doctors have to using it. Having some doctors still working with the paper record decreases the quality of the content of the IT system and especially contributes to the lack of a comprehensive picture of the patients' situation because the patient data are scattered in different places. Nurses also refer to the preference of some doctors to ask the nurse for data instead of looking it up directly in the IT system.

The positive impact on work dynamics includes helping the process of the coordination of tests, no paperwork, fewer phone calls and movement out of the units. Time saving is the main advantage here.

There is an interesting issue with the need of getting used to the system and the sense of the program having great potential nurses still have to discover. It highlights the need for time and ongoing training to facilitate the adaptation to and integration of the use of the IT system in daily practice.

9.2. DIFFERENCES IN NURSES PERCEPTIONS IN RELATION TO DIFFERENT UNIT CONTEXTS

Communication

Nurses in units with critical care patients and, specifically unit A, have the highest frequency of coded responses related to communication. They have a positive perception of communication within the health team but negative for communication within the nursing team. Routine changes especially during the shift report are the main reason. The shift change used to be with all the nurses around the table with

their paper graphics, each nurse got the information about the patient she was going to care for, but they have also a grasp of the rest of the patients' situation. Now it is done at the bedside around the computer and only with the nurses directly involved in the care of that patient. They miss the shared awareness of the unit and patients situation they used to have when using the paper record.

Nurses from units with medical and medical/surgical patients refer more to the decrease in verbal communication especially in the communication with doctors as they access or register data in the computer and do not speak to the nurse. Within the medical units, unit I is an exception; accessibility of data is seen by most of the nurses as a positive aspect for healthcare team communication and they do not mention a decrease in verbal communication.

Nurses working in units with surgical patients also see content and accessibility of information with the IT system as positive for healthcare team communication.

Information

Despite a general consensus on nurses' perspectives on information there are some specific issues raised in individual units. ICU nurses mention quite frequently their previous paper record and talk positively about it because they used to have a better global view of the patient situation. This could justify the more negative perception they have when compared to the rest of the units. They refer also to legibility of patient data with the IT system as a positive aspect of information within the IT system more frequently than nurses from other units.

It is also interesting to note the importance that nurses from unit I give to the quality of information content for patient care; many of the responses related to this theme include a reference to patient care.

There is also one comment that relates quality of information format with a certain type of patients:

> "lack of global view of *no standard* patients. Medical pathologies that affect different processes of the patient, in these cases the program is complicated" (q.109).

Documentation process

Two of the negative responses are associated with context variables related to the kind of patients:

> "The problem is with complicated patients. It is difficult to reflect well the patients problems and that the rest of the team understand it easily" (q.109) and
>
> "In units where the length of stay is short, a lot of time is lost recording too many data" (q.36).

In all the units the total coded responses for documentation are more positive than negative and there are not clear differences either in the frequencies or the content of the responses.

Patient care

There are no notable differences. Only that surgical units seem to be more negative about the impact of the IT system in patient care and it is consistently identified with the decrease of time dedicated to patients. The time they used to be with the patient, now, with the IT system, has to be distributed between the patient and the computer.

Running of the program

In relation to ease of use, ICU nurses refer to the previous paper record as easier than the IT system. Also the program is slow with long stay patients because of the amount of data recorded; it takes time to open the electronic patient record and it takes time to jump across the different applications.

In general, medical units are more negative than the medical/surgical and surgical ones. Patients in medical units are more complicated in relation to the co-ordination of tests and medication, and this could be an explanation of the difficulties with the use of the IT system experienced by nurses in these units.

Integration of the program in work dynamics

There are no differences either in the frequencies or in the content of the responses. All the units reflect the same advantages and problems of the integration of the IT system in work dynamics.

Other issues related to society context

Some nurses refer to the wider context of society where the tendency is towards an increasing introduction of technology, it is something that cannot be ignored and they have to make use of it. IT systems are seen as part of todays world and the perception is positive, not as an unavoidable event we have to live with but as an opportunity and advancement.

9.3. DIFFERENCES IN NURSES PERCEPTIONS REGARDING AGE

There are no clear differences across ages. Nevertheless, some subtle variations could be mentioned.

It is interesting to note that younger nurses tend to have a more balanced perception of communication having positive and negative aspects related to it and oldest nurses, those with more than 51 years, no mention communication at all.

In relation to documentation processes the youngest nurses, those under 25 years, are the ones that mention more frequently how the availability of protocols in the IT system helps them to plan patient care. They seem to be more worried about not forgetting to register anything important for patient care while the rest of the nurses focus more on the speed of the documentation process with the IT system.

Another issue is how youngest nurses are more specific when describing the impact that the IT system has in patient care; despite being the general category of patient care the most frequent, they mention more frequently than the rest age groups the impact on continuity and coordination of patient care and the impact on individualised care and decision making. In contrast, younger nurses are less specific about how the IT system affects daily work and they refer to it as just making work more organised. Older nurses mention it more frequently and specify how the IT system has reduced bureaucracy, simplified the processes of coordination of tests and reduced telephone calls and movement out of the units.

10. DISCUSSION

10. DISCUSSION

In accordance with the realistic evaluation framework, discussion of findings is structured around the concepts of context, mechanisms and outcomes in IT implementation. The potential of realistic evaluation to move forward IT implementation evaluation research is examined in the context of the actual debate on IT evaluation research. Recommendations for policy making, practice, education and further research are provided at the end.

10.1. AIM OF THE STUDY AND MAIN RESULTS

The main aim of the study was to provide a comprehensive evaluation of using an IT system in clinical practice from the nurses' perspective. Principal issues around information and information management have been addressed trying to establish a relationship between how the IT system works and the impact on clinical practice. Context variables have been taken into account in order to understand differences in nurses' perception and how individual and unit characteristics could influence the use and impact of IT system in clinical practice.

Success of IT implementation is multidimensional and complete evaluation is an overwhelming task. In this study the focus has been on nurses' perception of success leaving out other aspects, such as completeness of records.

Realistic evaluation has been used as a method and as a theoretical framework, looking at why and how the IT system works when implemented in clinical practice. From this theoretical framework the issue is that IT systems have to provide the reasons and resources to enable users to obtain the outcomes and it is the action of the different stakeholders that make them work (Carlsson 2003). Realistic evaluation

provides configurations of context-mechanism-outcomes that explain the underlying relationships to understand why and how a programme or intervention works. The study has been exploratory as a first step for further research on IT implementation. It tries to explain possible associations and uncover new possible context, mechanisms and outcomes variables that could be considered in further research.

Results show a positive perception of nurses in relation to the impact of the IT system in clinical practice. Overall satisfaction with the program is high and only 7.5% of the nurses wanted to return to paper records.

There are very slight differences in the perception of the different outcome factors, all of them are positive and teamwork is considered the least benefit from the IT system. In the same way nurses' accounts reflect how the IT system increases the sharing of information among the team members but, on the other hand, it decreases verbal communication. Patient care is positively influenced by the implementation of the IT system but the disadvantage is having less time to be with the patient because the system is considered time-consuming.

Looking at the mechanisms, support from the IT personnel is perceived as positive and there is confidence about their cooperation and comprehension of clinical practice in order to meaningfully develop and adapt the program to clinical practice. Usability of the program from both perspectives, the ease of use of the program and integration in daily work, is considered adequate with mean values between very positive and positive. This correlates with the high confidence nurses have with regards to their ability with the program.

Nurses also positively perceive information characteristics; nevertheless, when compared with the other mechanisms it is the least valued. Accessibility of

information is highly valued as an advantage of the IT system both from the quantitative and qualitative data. Quality of the documentation is good and it could be justified by the positive impact on the documentation process referred to in nurses' responses to open ended questions. Nevertheless, it does not give a complete picture of the patient for 54% of the nurses. It is due this way, in part, because not all the doctors use the IT system to record patient data or to access patient data, but there are also references in nurses' comments to the importance of nurses' accounts about the patient situation and the need to see the patient to make sense of data from the IT system.

Comparisons of results to look at possible differences between the different contexts variables provide interesting conclusions. Individual characteristics look as if they do not have an impact on mechanisms and outcomes, except attitudes towards the introduction of technology. Unit variables have an influence on both in bivariate analysis but multivariate analysis shows that the influence is on outcomes and not on mechanisms. Figure 10.1 represents the final model from the path analysis where only the significant associations are represented.

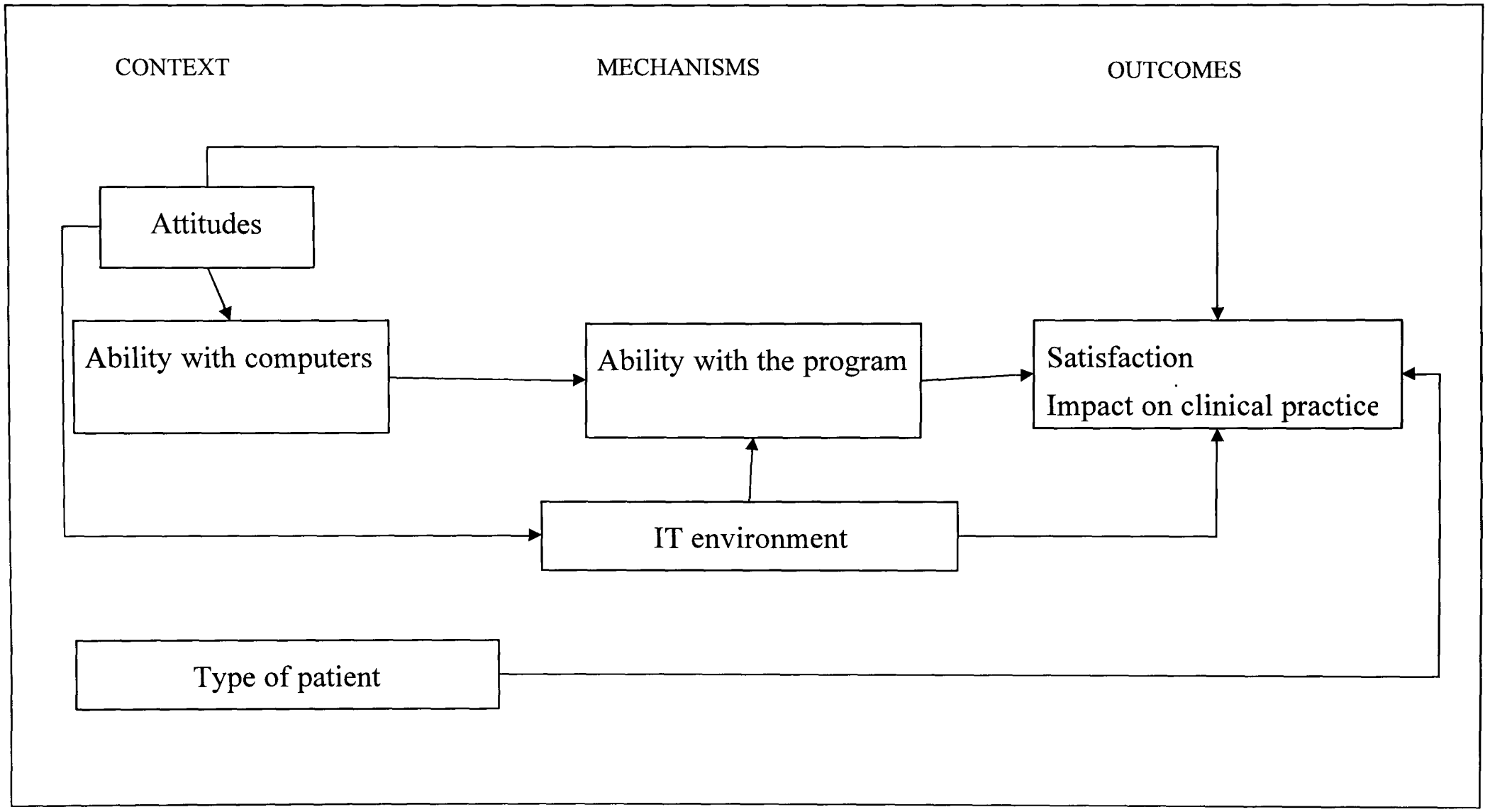
Results from open-ended questions also follow this pattern, only unit context variables seem to identify differences in themes and categories. Nurses' accounts also reflect cultural aspects and work habits or routines that influence their perceptions of the IT system: such as positive experience with previous paper record, changes in shift turnover and communication network.

Before proceeding with the discussion, there are limitations to the study which should be noted including the fact that this was one evaluation of one system on one site, therefore, the results have limited generalisabilty. Study design, instrument

design, administration, analysis and interpretation were all done by one person, which is the nature of a doctoral level study, but this makes the elimination of bias difficult in the presentation of the study. In addition, I was a senior manager in the hospital where the study took place so the issues of coercion to participate and the provision of socially desirable responses cannot be avoided.

To minimise coercion to participate I did not have direct contact with the nurses regarding their participation in the study. They were invited by letter and ward managers were responsible for facilitating their participation once they had expressed their willingness to do so.

Figure 10.1. Model of relationships between context, mechanisms and outcomes



10.2. MECHANISMS

Mechanisms in this study comprise issues around the characteristics and development of the program, how the IT system works. It revolves mostly around the concept of user-friendliness, looking at usability, because of system characteristics and integration in daily workflow, and the quality of the information it provides.

10.2.1. System characteristics

IT system characteristics are positively valued by nurses and it is interesting that, except for the positive score of closed-ended questions, they do not refer to aspects of navigability or the system being intuitive and ease of use in the open-ended questions. It seems that these aspects, also with reference to the literature, are taken for granted and only when they are not present are reflected on by users (Darbyshire 2004). Very few nursing studies have addressed this directly, such as Staggers and Kobus (2000) study comparing different user interfaces and nurses' responses to them. Nevertheless, technical problems (system downtime, unexpected interruptions, slowness, etc) are still a significant issue (Moody et al 2004; Lee, 2004; Axford and Carter 1996). In this study, answering the questions about the main problems with the IT system, almost 60% of the answers are related to technical problems. It is not the IT program itself but the IT structure that supports it that needs further development in order to facilitate the use of IT systems in clinical practice.

It is interesting that the concept of *getting used* to the program that nurses report in relation to their confidence in using the IT system; time and training, even more than ease of use, are the most influential factors identified and they see it as an ongoing process.

10.2.2. Adaptation to workflow

One of the main problems identified in the literature in relation to the usability of IT systems is the lack of adaptation to workflow and the IT systems not being clinically relevant, but instead appear to be designed for legal or management purposes (Urquart and Currel 2005). It is worth highlighting that nurses in this study positively valued this aspect, even more than the system characteristics; the program is integrated in the workflow and makes their work easier and also it is clinically relevant as data they enter in the IT system is important for the care of patients. Trying to identify aspects of the IT system evaluated that would have contributed to this perception, there are two that stand out: the type of IT system and user involvement.

An integrated IT system is one of the characteristics highlighted by the literature as contributing to these systems being clinically relevant. Rosenbloom et al (2007) says how "Bringing together computerised tools that allow providers simultaneously to document and order as part of a single workflow enhanced adoption of a documentation system" (p.110). The IT system that has been evaluated fulfils this requirement and nurses in the study agree, positively valuing the opportunity that the system provides not only to document and access patient data but also to order and coordinate the whole patient care process. It is a patient-centred system where the same system is used to document assessment and planning of care by the different professionals of the health team, to access patient medication, order and coordinate tests and access to results and so on. As it was explained in the introduction, the vision of the IT project is a focus on patient care. Data and functionality are for patient care, although it can be used for management purposes as well.

Another issue consistently raised by authors is the importance of user involvement in design and implementation (Urquart and Currell 2005; Fraenkel et al 2003). It has been identified as relevant for effective implementation as it favours incorporation of users needs but also as relevant for users' acceptance as it generates a sense of ownership (Urquart and Currell 2005). In this study this issue has not been directly addressed as the design and implementation phases of the project have not been analysed. Nevertheless, the positive perception nurses have of IT support could be considered a consequence of taking into account users' perspective. Nurses feel that people in charge of the development and improvement of the program understand their problems and that changes introduced are relevant for their work. They also perceived that their suggestions have an impact in the program improvement process.

Being a self developed IT system could have help to contribute to the sense of ownership and adaptation to workflow. IT personnel and clinicians from the hospital are responsible for developing and upgrading the IT system, there is no need to adapt a vendor system to the organisation because it is a system designed for the organisation. Bostrom et al (2006) describe the challenging process of adapting a vendor system, and lessons learned include the need of vendors to understand the complexities of practice and the importance of clinical staff being involved in all phases of the implementation. They also reflect the difficulties of adapting a larger program, intended to fit multiple organisations, to the actual setting and needs.

It is important to bear in mind the agreement of authors to recognise the mutual influence between the IT system and the work routines in place. "Implementing information technologies necessarily transforms the healthcare practice at stake - this is unavoidable and, moreover, a central and legitimate reason to acquire IT

technology" (Goorman and Berg 2000, p. 7). Nurses in the study also refer to changes in the work routine after the implementation of the IT system. In this sense, user involvement has even a greater relevance, it is not just a question of acknowledging users needs but a way to foresee and understand the impact and consequences it will have in clinical practice.

10.2.3. Information characteristics

Accessibility of data is the most valued aspect on information characteristics and it corresponds to what has been pointed out in other studies (Embi et al 2004; Vassar et al 1999). IT systems offer a great opportunity to improve the way of recording patient data and therefore to improve the quality of information content both in quantity and quality, having more information and being more accessible and usable. Nurses are satisfied with the quality of content emphasising the multidisciplinary approach of the IT system; it provides a unified way to collect patient data from all the professionals involved in patient care. This multidisciplinary approach has been highlighted in the literature as a key characteristic of the IT system for effective implementation (Fraenkel et al 2003) and Urquart and Currell (2005) recognise that it is a consequence of the IT system being carefully grounded in reflection on practice.

10.2.4. Documentation processes

A significant issue, which came up in responses to open-ended questions around adaptation to workflow, is the integration and impact of the IT system in the documentation processes, how the IT system supports the documentation processes and changes that came up after introducing the IT system.

Nurses recognise that it is easier to document with the IT system and identify some of the IT system characteristics, such as standard care plans as a reminder to encourage completeness or structured data that facilitates assessment data being consistently recorded across the hospital. On the other hand, easiness and an increased interest in healthcare organisations on quality and safety programs could have provoked an over documentation problem, with lengthy and not always better documentation (Embi et al 2004). Nurses in the study also reflect how the documentation in some cases, especially with short-stay patients, is too bng and not all data are needed for patient care, more data is not the hallmark of good documentation.

The use of structured data is considered as one of the advantages of the IT system implementation and a condition for completeness but nurses reflect having problems to fit the patient situation, especially psychological aspects, into the "structure" provided (Urquart and Currel 2005; Lee and Chang 2004; Lamond 2000). The need for free text and narrative has been suggested in recent studies (Rosebloom et al 2007; Lee 2004). Together with pointing out problems to reflect some patient situations with structured data. It is interesting to note how nurses, despite using structured data for recording, use unstructured data, the free text written at the end of the shift, to learn about the patient. Structured data seems to be not only a problem to reflect some patient situations, but of limited use to know the patient. But, is it a problem of the IT system or an old routine from paper documentation still in place? As Rosebloom et al (2007) suggests "there may be a tension between narrative expressively and structure" (p. 111); there should be a balance to make better use of IT system opportunities to improve completeness and coherence through structure and analyse possible misuse of free text because of routine.

IT systems are often introduced in the complexity of documentation processes around patient care, where the IT system, considered as the electronic patient record, coexists with other ways to record patient data and with different levels of formality (Fitzpatrick 2004). Nurses, despite the introduction of an IT system, continue using other means of managing patient data while caring for the patient, like "scraps", and use the IT system to record patient data at the end of the shift. They do not see scraps as patient documentation but as a working tool. Hardey et al (2000) analysing the role of "scraps", suggest that, while considering them as a sign of paper documentation inadequacies, "it would be wrong to assume that innovations to formal documents would consequently mark a decline in the role of scraps" (p. 214). It is important when evaluating the implementation of a new system to consider how old habits could live together with changes, whether they are a consequence of misuse or inadequacies of the new system and differentiate them from a lack of adaptation of work processes to change. Up to now most of the research on IT implementation in healthcare has been focused on a patient-centred perspective, translating the conception of the paper record to the capabilities of IT systems. Nevertheless, capabilities of IT systems and the consideration of the mutual influence of IT system and the working processes where they are implemented, should move research to a wider perspective, analysing IT systems in the context of overall documentation processes. The concept of a "working patient record" described by Fitzpatrick (2004) could be an starting point and as she says "the challenge is to provide clinician-centred support for their role in the delivery of care while providing a patient-centred coherence to that care both within and across settings (p. 301).

10.3. OUTCOMES

Results in the study show an overall satisfaction with the program and nurses' comments point out a degree of confidence in the greater possibilities it has. Nurses do not want to go back to paper and, despite having some problems, they feel that the IT system has a potential that need to be explored and implemented. Patient care and communication are the main outcomes identified as being the rationale for IT implementation.

10.3.1. Patient care

Nurses make clear the relationship between documentation and patient care and they point out that the reason for good documentation is patient care. Nevertheless, the IT system has both positive and negative impact on patient care.

Lee (2005b) points out that there is no empirical evidence that the lack of good documentation decreased the quality of care. On the other hand, measuring the impact on patient care is not an easy task and very few evaluations focus on that (Kaplan and Shaw 2004). Nurses in the study also have difficulties stating specific issues around impact on patient care, and in open-ended questions talk in general about patient care except for issues relating to patient safety. No problems with transcription and misreading were two of the issues raised. Decreased risk of errors is one of the reasons identified for a positive impact and, in many cases, the principal motivation for healthcare organisations to incorporate IT systems; the widespread use of applications on prescription and administration of medication are a good example of this.

It is interesting to note that nurses do not mention de-individualised patient care as an outcome of IT implementation as compared with other studies, where standardised patient care plans are identified as a possible reason (Lee 2005b). The flexibility of the system suggests a range of activities to select but does not impose the plan of care and users' involvement in developing and upgrading their own standardised care plans could contribute to this perception. On the other hand, standardised care plans are seen as a help for younger nurses to develop more complete and better plans of care.

Dillon et al's (2005) study on nurses' views of IT implementation found also that nurses' concerns were about the effect of the IT system on patient care and dehumanising was one of the factors with a higher score. There is a concern around computers and losing the human component of nurses' work. This can tie in with the concept of time around patient care. Most of the negative responses talk about there being less time with patients, being in front of the computer and feeling they should be with the patient. Recent studies share the same results (Embi et al 2004). Studies on time perceptions and differences between paper and computerised records suggest mixed results (Urquhart and Currell 2005; Axford and Carter 1996). It could be possible that the introduction of IT systems has brought an increase in documentation time because more data are recorded but, on the other hand, it has simplified processes and saved time on phone calls and movement out of the units. Therefore, is it that nurses spend a lot of time in front of the computer or that perception of time being in front of the computer is seen as dehumanising? Social image of computers and their impact on human relations can have an influence in this aspect and it could be an interesting issue for further analysis.

10.3.2. Communication

Communication is generally identified as an outcome of IT implementation but conflicting results can be found when results are thoroughly analysed. Overall evaluation of the impact in communication is positive but in open-ended questions some aspects turn out to be negative.

Documentation is considered as a communication tool and IT systems have supposedly increased this capability; accessibility of data and more complete documentation improve communication. Nevertheless, nurses refer to a negative impact on communication because of a decrease in verbal communication, whether because of having more information at hand or whether they spend more time on the computer and have less time to talk to each other. Embi et al (2004), in a recent study of the impact of IT system on physicians, found similar results and noted that changes in work processes have a direct effect on communication.

Changes in the handover, both in the way and the place it is done, are most frequently identified as being affected by the use of the IT system. They have been considered as having a negative impact on communication within the nursing team: more individualised work and less time to talk to each other. Nurses in ICU highlight how the change of the place of the handover, from the central station to the bedside, has had a negative influence on nursing teamwork. On the other hand, Ammenwerth et al (2003b) find more negative results in one ward and they point out the influence of the change of the way of documenting from bedside to the nursing office, where computers have been installed. Therefore, is not a question of where documentation takes place, but the change itself that has a negative effect. IT systems have been

introduced without consideration of the wider context of communication that might have required adaptation prior to implementation.

It seems that, in the same way that the introduction of the IT system has had an impact on documentation processes, it has also had an impact on communication processes. Interaction and verbal communication are viewed as key aspects for teamwork and patient care and changes in communication patterns are seen with caution (Chiasson et al 2007; Embi et al 2004). Verbal communication is not dependent on the amount of information available and the need of face to face communication cannot be obviated as conversations allow for a give and take of ideas that optimise the making up of decisions (Embi et al 2004; Brown et al 2004; Coiera 2000). "Although initially conceived as a means of providing patient-specific information for individual patient care, clinical systems such as the electronic patient record have played a more collaborative role than originally anticipated by their designers. Changing from a paper-based to an electronic patient record affects stabilised communication practices, altering the content and patterns of interdepartmental communication" (Chiasson et al 2007, p. S92). Evaluation systems should consider IT systems implementation in the context of communication processes for a better understanding of the relationship between communication and information to try a blending of information and communication tools (Coiera 2000).

On the other hand, cultural aspects as it was seen in patient care, could have also contributed to the negative perception: being in front of the computer is understood as excluding human communication.

10.4. CONTEXT

The person, the unit and the organisation have been considered as aspects to take into account when analysing IT implementation. Users characteristics influence has been widely analyse in IT evaluation but studies related to the nursing unit context or the wider context of the organisation are rare.

10.4.1. User characteristics

The literature points out conflicting results in relation to differences in evaluation results regarding individual characteristics (age, experience, attitude, etc) but usually there are not significant differences (Lee 2004). This study resembles this tendency and only attitudes towards introduction of technology have a significant impact on perception of both mechanisms and outcomes. Attitude has been considered as a key aspect for effectiveness in the implementation of an IT system in clinical practice, but attention to this aspect should considered not only the significance of the relationship but the magnitude of the overall possible influence. In this study 3.5% of nurses have a negative attitude but the possible influence of this attitude could be easily counteracted by the 96.5% of nurses with positive attitude.

Another issue that needs to be considered when analysing attitudes is the difference between attitudes and satisfaction. Studies measuring attitudes pre and post-implementation show conflicting results, but to what extent post-implementation measures, when they focus on IT systems in clinical practice, could be considered attitude? Smith et al (2005) measured nurses attitudes before and after the implementation of an IT system and found a decrease in attitude scores. Nevertheless, we can suppose that, once nurses have used an IT system what they are doing is evaluating their experience, it is more a measure of satisfaction than a

measure of attitudes towards the introduction of IT systems in practice. In this study, in order to avoid bias, attitude score is related to the introduction of technology in society and not focused on clinical practice, as experience using an IT system in clinical practice could change attitude to satisfaction.

Finally, cultural aspects could influence attitudes. Getting used to computers because of the growing acceptance of technology in society results in a more positive attitude (Dillon et al 2005) but also the consideration of computers as dehumanising relationships could have an influence as it was addressed in relation to the impact of IT implementation in patient care and teamwork. It is interesting to note that the nurses in the study are optimistic about the increasing introduction of technology in society and see it as an opportunity and an advancement.

10.4.2. Unit characteristics

Activity indicators (intensity, occupancy rate, fluctuation) have not demonstrated an impact on either mechanisms or outcomes. Nevertheless, comparison within the individual units and the type of units or patients, a more conceptual or abstract grouping of the individual units, have significant results and, in the final model, they have a direct impact on outcomes. These results share the actual tendency to highlight the importance of professional culture and working practices on IT implementation (Timmons 2002).

The introduction of IT systems has been considered as a transformational tool, "one that ultimately changes how we work and how we think about our work" (McLane 2005, p. 87). The mutual influence of IT systems and the context in which they are implemented emphasises this perspective and some issues addressed in relation to the impact on documentation and communication processes support it. Further analysis

on these aspects will help to ascertain other unit and organisational context characteristics.

Some issues raised by nurses point out context characteristics that could have an influence on perception. For example, it is interesting that ICU nurses generally have more negative perception and, in responses to open-ended questions, there is constant reference to the previous paper-record as having advantages over and above the IT system. Implementation of IT systems entail changes in documentation processes and a recognition of the inadequacy of previous documentation makes a difference in the perception of advantages (Bjorwell et al 2002).

Differences in relation to communication also help to highlight issues around unit characteristics. Medical units, despite a generally more positive perception, in responses to open-ended questions refer to a negative impact of accessibility of information on communication in the health team that surgical units perceive as positive. Medical patients with multiple processes and a great need of co-ordination among different teams compared with surgical patients being more standardised could explain this difference.

10.4.3. Organisation context

The focus of this study has been the person and the unit, as the wider context of organisation, being just one organisation, cannot be addressed for comparison. Nevertheless, some aspects related to organisational characteristics in relation to the type of IT system implemented and characteristics of the project have been addressed in the discussion.

Furthermore, a description of the organisational characteristics has been provided in the introduction and could help further comparison with other studies for a better understanding of organisational context influence on IT system implementation.

10.5. REALISTIC EVALUATION AND IT SYSTEMS EVALUATION RESEARCH

Most recent frameworks for IT evaluation focus on social relationships and the socio-technical approach, described by Berg, is considered as based on a strong theoretical foundation (Currie 2005). It addresses context, users and functionality and considers the mutual influence of the system and the context, this being an iterative process. Realistic evaluation in this study has proved to be, from the evaluation research perspective, an adequate method to acknowledge these issues. Context and functionality have been examined and the mutual influence between context and the IT system became apparent in data analysis, especially in responses to open-ended questions.

Based up on theory-based evaluation research, it explains causality in terms of generative mechanisms; causal relationships are not straightforward as context factors can modify outcomes; mechanisms should be in the right context to produce the expected outcomes. Furthermore, the aim of the evaluation is not to demonstrate that the IT system works but to understand how it works, which are the links between context, mechanisms and outcomes. Kaplan and Shaw (2004) recommendations for IT evaluation highlights this idea: "Thus evaluation needs to address more than how well a system works. Evaluation also needs to address how well a system works with particular users in a particular setting, and further, why it works that way there, and what *works* itself means" (p. 220). Despite not having clear-cut CMO configurations

as a result of the study, underlying mechanisms in the context of communication and information management processes have been pointed out as a way forward for a better understanding of comprehensive implementation of IT systems. Also, nursing units with clear-cut differences, such as ICU with the most negative perception of outcomes or medical and surgical units with differences in the impact of the IT system on communication within the health team, could provide the context for in-depth case analysis to understand underlying mechanisms further that bring about these differences. As Kazi (2003) says: "The gold standard for the realist evaluator is not just 'what works', but 'what works, for whom and in what contexts', recognising that an explanation at any one time requires further investigation and further explanation" (p. 160).

One of the criticisms of evaluation studies is that they tend to be undertheorised (Kaplan and Shaw 2004). The use of frameworks has been recommended as a way forward to contribute to theory development (Chiasson 2007). Classification of items into the context, mechanisms and outcomes structure of realistic evaluation has helped to clarify how variables are understood and used for analysis. It gives a comprehensive evaluation of how variables predict outcomes or influence them. Realistic evaluation approaches to theory development based on realistic cumulation provides the foundation for the integration of findings from different studies and contributes to generate theory across studies where "individual studies can build into cumulative bodies of generalizable and transferable knowledge" (Kaplan and Shaw 2004, p. 225).

Finally, the recognition of the importance of social factors in IT implementation has led to a growing interest on qualitative methods in IT research (Chiasson 2007;

Lising and Kennedy 2005; Kaplan and Shaw 2004). Different studies have combined quantitative and qualitative methods to gain deeper insight on quantitative results (Lee 2005a; Ammenwerth 2003b). Realistic evaluation allows a combination of methods that "offer something more than *weight of evidence* but also should invite a sense of explanatory *completeness, synthesis or closure*" (Pawson and Tilley 1997, p.158). Therefore, it is not the sum of results but the integration of results in the same CMO configuration structure.

Carlsson (2004) points out the major contribution that critical realism could have in: "(1) IS (information systems) evaluation research, (2) artefact construction and design science, and (3) studies on IS discourses" (p. 334).

10.6. LIMITATIONS

Success could be explained by context variables different from those at user and unit level. Organisational variables (technology culture, innovation, leadership) and other variables (user involvement in IT design and implementation, type of IT system) are common to all the units in the study so comparison to acknowledge their impact has not been feasible.

Discrimination of users' characteristics in relation to their impact on IT system implementation could have been influenced by the homogeneity of the sample. Despite being the total population, almost 70% were less than 36 years old, had good ability with computers and a positive attitude towards the introduction of technology. Other studies have similar results but because of sample characteristics in this study results in relation to users' characteristics should be taken cautiously.

Nurses' perceptions are just one dimension of effectiveness. More objective dimensions such as completeness or impact on patient safety and quality of care could have been interesting. Nevertheless, they are not specifically relevant in this study because patient documentation is shared by all the team and therefore it is not appropriate to attach record quality to one nurse for comparison purposes.

On the other hand, only nurses' perspectives have been included knowing that there are other key stakeholders that could be considered (patients, ward managers, doctors, IT personnel) for a more comprehensive picture of IT implementation. The need to delimitate the study for making it viable and manageable leaves the exploration of these perspectives as a possible and interesting continuity of the study.

The study intended to provide a wider picture on IT implementation and within realistic evaluation I have chosen a more extensive research design. As Kazi (2003) points out a more extensive approach "address research questions regarding the regularities, patterns and distinguishing features of a population" (p. 32) but it could lack in explanatory depth. Interesting issues have been raised along data analysis and discussion but further research is needed for in-depth understanding of them.

Another issue is the variety of types of data that have been included in the questionnaire. Multiple statistical tests have been necessary to fit different types of data and could have complicated the analysis and interpretation of results. Despite being valid and reliable, further use of the instrument needs to consider a unification of the types of data to make analysis more straightforward.

Lastly, this was a cross-sectional study and therefore limited in giving some idea on changes along the process of IT implementation. In addition, as being a single case study, generation of robust theory about relationships between context, mechanisms

and outcomes is not possible; "generating robust theory is normally a lengthy procedure" (McEvoy and Richards 2003, p.415).

10.7. CONTRIBUTIONS

The study provides a valid and reliable instrument to evaluate nurses' perception of the use of IT systems in clinical practice that could be used in other studies. The process of the questionnaire development and analysis of validity and reliability have been rigorously defined and described. Factor analysis has contributed to modify initial dimensions and variables included in the questionnaire and has generated a set of posteriori constructs that could be used in future research Questionnaires are the main method for data collection in research in IT implementation and therefore development of instruments with description and analysis of psychometric properties help to interpret results in a meaningful way and to advance in this field in a coherent and comparable way (Rattray and Jones 2007). In addition, despite containing mainly close-ended questions, it incorporates qualitative data in the form of open-ended questions that allow uncovering underlying dimensions for further research and improvement of the instrument.

It presents a comprehensive users perspective incorporating multiple factors and combining methods. In the context of the quantitative analysis, the use of path analysis has contributed to disentangle significant relationships between variables, analysing direct and indirect effects among context, mechanisms and outcomes. It has provided a tentative model of CMO relationships for further research. One of the key aspects for effective implementation is knowing how nurses view and experience the use of IT in their daily practice. Dillon et al (2005) show a direct effect of image profile of IT implementation on attitude toward the introduction of IT systems. The

contribution has an added value as it provides the nurses' perspective after five years of implementation, once initial stages and problems are overcome. Nurses are more objective in their opinions and they are also able to point out the impact of IT systems in work processes from a wider perspective.

It contributes to fill in a gap on IT evaluation research because of inadequate research into the reality of workplaces, and, therefore, to highlight "key features of the work which appear relevant to the participants and which have consequences for any future deployment of technology" (Jenkings 2004, p. 322). Results from the study looking to subtle variations in users and units provide a grasp of how important professional culture and working practices could be in IT implementation.

It demonstrates the potential of realistic evaluation as an adequate approach for IT system evaluation. Results acknowledge the multidimensional nature of IT systems and the influence of contextual factors. IT systems implementation can be considered as an open system where how the IT system works interact with mechanisms in place; realistic evaluation seems to be an adequate method to uncover underlying mechanisms that help to explain how and why an IT systems works.

Generalisation of results is not possible but the use of a framework to guide the evaluation process improves reliability and increase rigor in research (Currie 2005). The study provides the first step in realistic cumulation and makes possible to consider transferability of the results to other cases. The study provides a theoretical rationale that facilitates to make decisions about how to adapt this experience to specific circumstances (McEvoy and Richards 2003).

10.8. RECOMMENDATIONS

10.8.1. Recommendations for policy making, practice and education

The main findings and conclusions were presented to the hospital to those responsible for the development and improvement of the IT system. In addition to minor recommendations to incorporate into the functions of the IT system, a change in the approach of the development and improvement of the IT system, from a repository of information to a communication tool, need to be put forward. In-depth analysis of the communication process already in place after the introduction of the system needs to be carried out. Adaptation of the IT system to the communication needs of professionals and adaptation of professionals to the capabilities of the IT system to enhance and support communication processes needs careful consideration.

An initial step has already been taken with a project to enhance communication among nurses during the shift report. The purpose is twofold: to improve the information provided during the shift report and to integrate the recording and communication actions regarding the use of the IT system. A new function is being developed that would provide nurses with the possibility of recording patient data during the shift and simultaneously generating the shift report. Indirectly, the new function will improve the quality and quantity of the patient documentation, enhancing coherence and completeness.

Increased interest on quality and safety issues in healthcare organisations are provoking a rapid incorporation of IT systems for clinical practice. Investment in IT is significant and to guarantee effectiveness is crucial. Some recommendations can also be suggested in this direction from the results of this study.

Patient care should be the main aim of the IT system, it has have to be clinically relevant and adapted to workflow. Healthcare organisations should consider clinicians input on IT self development or adaptation of a vendor system. Acknowledging working practices in the organisation would help to develop effective IT systems that are efficiently implemented in clinical practice. In addition to a good IT system, resources should be provided in order to make possible the use of it: computers, printers, capacity of computers, server and networking for quickness.

On the other hand, clinically relevant IT systems imply integrated programs that unify patient data from all healthcare professionals. Flexibility to adapt to the different users needs and to give comprehensive information about the patient is one of the biggest challenges for IT system developers in clinical practice.

Organisations need to be aware of the increased documentation as a consequence of the implementation of IT systems. They provide a way to input more data but this means more time dedicated to documentation. Work processes need to be analysed to balance time savings from the simplification of some work processes and time consuming documentation tasks with IT systems. Space and time should be provided to facilitate clinicians' use of IT system in clinical practice.

Training of nurses and other healthcare professionals should consider the use of IT systems as part of the curricula. It is important to differentiate between the use of IT systems and information management processes. Training should be focused on the use of information provided by IT systems for decision making and the care of patients and not only on how to use computers or a specific program. Pask and Saunders (2004) say that "Frequent use of the Web may improve computer skills and

build confidence in finding some useful information, but it does not necessarily improve critical thinking or guide analysis of the information found" (p. 63). The use of IT systems in clinical practice is more than knowing how to use the system to document; nursing students should learn and develop skills beyond the recording role and move forward to an understanding of how information could be used to enhanced their clinical role.

10.8.2. Recommendations for further research

IT evaluation research has moved from an initial stage focused on the technical aspects to a wider perspective of interaction of users and system and the impact of organisational issues. Human factors are the main point of interest. A wider perspective needs to be included, analysing IT systems in the overall context of the documentation and communication processes.

The unit and organisational context needs to be explicitly addressed. Cultural issues and the work environment have an unexplored influence that could be critical for effective implementation and development of IT systems. "Research employing different levels of granularity and different units and level of analysis, and research investigating how changes ripple across them may provide not only new insights, but also challenge basic assumptions derived from traditionally focused studies" (Kaplan and Shaw 2004, p. 224). Comparison studies within and between different organisations could help to further understand this influence.

More empirical data based on theoretical frameworks, both from IT and evaluation research could help to learn from results and translate experiences from one place to another. Integration of results from different studies with theoretical background

could help cumulation and theory development on IT implementation in healthcare, guiding further design and implementation for effective use of IT systems.

Replication of the study in other organisations following the realistic evaluation approach will help to further differentiation of context, mechanisms and outcomes and to establish grounded causal relationships.

10.8.2.1. Potential of realistic evaluation for nursing research.

Today's healthcare environment demands high quality services; evidence based practice, effectiveness and quality assurance are terms widely used and nursing as part of healthcare organisations is expected to function in this context. "Nurses practice in a professional environment which is necessarily knowledge-centred, outcome evidence seeking and efficiency driven" (Tolson 1999, p. 381).

From this point of view, evaluation research becomes an important issue as it provides the means to demonstrate effectiveness and it has also an important role in change and practice development (Bate and Robert 2002). "Therefore, there are two main purposes of evaluation research – providing evidence of the merit and worth of social work practices, and striving to improve practice itself to respond to the changing needs and contexts, for betterment of society" (Kazi 2003, p. 2).

The complexity of the healthcare environment and the relevance of translating knowledge into practice emphasise the importance of not just knowing that an intervention works but also to understand how and why it works, which are the aims of theory-driven approaches to evaluation research. Because of the complexity, the relationship between the intervention and outcomes are not straightforward; clinical practice settings in healthcare are rapidly changing and they have elements that

influence individual experience within those environments (Wilson and McCormack 2006). Practice in human services takes place in open systems: interconnected structures, mechanisms and outcomes. "The complexities of practice for the human services are such that there are several dimensions in a continuous state of flux; for example, the content of interventions, the value base of practitioners, the outcomes of practice, the perspectives of all the different people involved, and the contexts of practice" (Kazi 2003, p. 10). Evidence based practice implies translation of knowledge into practice, and this means to know what is relevant to implement but also how it has to be implemented in different situations to understand the implications in a specific situation. "Thanks to context, there will always be a footprint of programme success or failure" (Pawson 2006, p. 25). Realistic evaluation provides a framework where data collection and analysis acknowledge the role of context and acknowledge the interplay between the intervention and the mechanisms already in place (McEvoy and Richards 2003; Pawson and Tilley 1997). As an example, McCormack and Slater (2006) use realistic evaluation as an exploratory evaluation of the role of the clinical education facilitator to develop a learning culture in a large teaching hospital. The study comprises both quantitative (survey) and qualitative data (interviews). Results highlight how mechanisms related to the role of the clinical education facilitator were influence by the organisational context. "Dominant mechanisms in place inhibited the success of the role, as there were few opportunities to translate education and training provided into tangible evidence of practice development" (p.143).

Furthermore, realistic evaluation provides a comprehensive framework for combination of methods which is increasingly being recognised as a way forward in evaluation research as quantitative methods do not fully answer questions in complex

healthcare environments (Kinn and Curzio 2005). Wilson and McCormack (2006) point out how "purely constructivists would fail to capture the scope of reality and experience" and "purely positivist exclude many unobservable, unmeasurable phenomena which are essential components of a clinical setting" (p. 52).

On the other hand, the searching of CMO configurations help to organise data and to combine variables for analysis in complex situations within a coherent framework. Byng et al (2005) carried out a multiple case study using realistic evaluation as the framework for data collection and analysis. The study follows a quantitative evaluation research because of "a need to understand, rather than simply describe" (p. 71) and therefore as an attempt at making sense of a quantitative results. One of the problems they found is that, because of the complexity of the intervention, they found construction of CMO configurations, to some extent, overwhelming but at the same time more important. Moving from the big picture of multiple contexts and mechanisms they were able to design simpler CMO configurations and analyse mechanisms specifically contingent in different cases. As a conclusion they found realistic evaluation as a practical research approach and "the search for CMO configurations improved our understanding of what had happened" (p. 90). It is also interesting how both positive and negative cases help to understand how the intervention works. Realistic evaluation searches outcomes patterns and not regularities so "it is the totality of outcomes –successful, unsuccessful, bit of both – that may act as an initial empirical guide for future optimal locations" (Pawson 2006, p. 22).

Authors emphasise the importance of a shift to evaluations that have a cumulative component and take into account context and process as well as outcomes. Redfern

et al (2003) analyse three recent evaluations of changes in practice development in healthcare and conclude that "evaluations should attend to development of explanatory frameworks that can ensure generalizability through theory building and can accommodate changing context" (p. 241). Realistic evaluation, together with the methodological technique, gives the possibility of theory and knowledge development: how and why an intervention has the potential to cause a desired outcome. Cumulation and convergence of results from different studies using a realistic approach will uncover general principles moving theory development from specification to higher levels of abstraction; "scientific knowledge begins to accumulate when the same generative mechanisms are used generically" (Pawson 2006, p. 23). It develops middle range theories that provide the analytical framework to interpret different implementations. "The purpose of realist scientific explanation is not just to predict; it is to explain and to improve the explanation. The goal is to understand how the phenomena under study react or change in the presence or absence of other antecedent or concurrent phenomena in an open system. These theories are empirically assessed and, when found to be empirically adequate, are themselves explained in turn, in the cognitive unfolding of explanatory knowledge" (Kazi 2003, p. 26).

Realistic evaluation potential is not restricted to being a framework for research; it has also an important role as a framework for practice. "A *realist effectiveness cycle* is proposed that enables an integration of realist evaluation procedures into a programme's practice, and establishes a direct link between practice and evaluation in order to improve practice (Kazi 2003, p. 7). Tolson et al (2007) use realistic evaluation to evaluate, refine and inform on going development of a managed clinical network (MCN) in palliative care. They demonstrate the effectiveness of

realistic evaluation as a way of improvement of practice and conclude how "adopting a realistic evaluation design has proved a facilitative approach to inform ongoing refinements and offers an example of a strategy for making research work for practice" (p. 194).

Realistic evaluation potential is acknowledged by different authors and, without underestimating other approaches, it could provide a way forward in nursing evaluation research. Results from studies following realistic evaluation would help practitioners to translate knowledge into practice and to have a reflexive inquiry approach when implementing changes and developing practice. On the other hand, development of transferable theory could follow evidence from a theory-driven approach as it is realistic evaluation.

Studies from a realistic evaluation perspective are still rare and research is needed to further develop the method and further understanding of its potential and limitations. "Critical realism promises much as an approach that encourages us to look beyond surface appearances in order to search for the underlying processes that account for natural and social phenomena. The challenge for nurses who adopt a critical realist standpoint within evaluation research is to demonstrate its practical efficacy and show that it offers more than speculative theory and critique" (McEvoy and Richards 2003, p. 418).

11. CONCLUSIONS

11. CONCLUSIONS

The study has provided a wider picture of the impact of IT systems in clinical practice. It can be considered a successful story of IT implementation that has demonstrated not just a positive outcome but it has also provided explanations through cross-tabulation of outcomes variables against other variables and answers to open-ended questions. Although variables related to culture, norms, values and work patterns have not been explicitly included, the influence of the work environment became apparent as a result of the analysis. Activity variables have no influence on nurses' perception whereas differences in individual units or more conceptual grouping of units are significant. These aspects need to be explored more systematically to understand their role on IT implementation.

This research has ascertained some key aspects on IT systems implementation in clinical practice. Issues around the impact on processes already in place in the clinical setting provide a wider perspective with implications for design, implementation and ongoing improvement of IT systems for clinical practice. Nurses perceive a change in communication and documentation processes and see these changes, to some extent, as endangering the quality of patient care. In some cases, it seems that old patterns of interaction or old routines remain despite the introduction of the IT system, such as the handover ritual; and, in other cases new patterns have emerged without conscious consideration of the implications in patient care, such as the decrease in verbal communication within the healthcare team. IT systems need to be understood in the wider context of the work practices to guarantee that they do not disrupt essential mechanisms of clinical practice and to adapt work patterns to make the most of the potential of IT systems for clinical practice.

In this context, an understanding of users perspectives and involvement of users in IT design has been demonstrated as a relevant aspect for effective implementation. Nurses' responses to open-ended questions in the study have made an enormous contribution to the results of this study, not only clarifying issues I had already mentioned in the questionnaire, but also raising new concepts and ideas.

The novelty of the socio-technical approach on IT systems evaluation suggested in the recent literature appear to be an adequate theoretical underpinning on IT evaluation research. It acknowledges the relevance of user perspective and context as essential aspects on IT implementation.

Realistic evaluation has proven to be an adequate method for IT evaluation. Theoretical foundation of realistic evaluation: generative mechanisms and embeddedness, has been demonstrated as relevant aspects of the reality of IT systems use in clinical practice. The interaction of IT system implementation and processes already in place, especially communication and documentation processes, became apparent on nurses responses. Effectiveness of IT implementation cannot be reduced to outcome variables as context and users factors could determine implementation. Understanding of how and why an IT system works have a greater impact on future design and implementation that knowing that it works. On the other hand, structuring data around the concepts of context, mechanisms and outcomes and exploring possible relationships have provided a comprehensive approach to disentangle the complexity of IT evaluation research.

Based on my experience carrying out this study and exploration of nursing literature on realistic evaluation, the potential of realistic evaluation in nursing research is suggested. Nursing interventions occur in the complexity of healthcare environment and understanding of their implications and impact cannot be isolated from this

wider perspective. Context and work practices already in place can play an important role and need to be taken into consideration. Knowing how and why an interventions has worked could be better evidence to guide translation of research into practice than just knowing that it has worked. Realistic evaluation could have an impact in nursing evaluation research, evidence-based practice and practice development. Further use would help to elucidate strengths and limitations of this method and to develop adequate methods to carry out realistic evaluation.

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13. APPENDICES

APPENDIX 1

Ethical approval from the hospital Ethics Committee

Clínica Universitaria
Facultad de Medicina
Universidad de Navarra

Comisión de Ética de Investigación

Teléfonos.
Central 948/ 25 54 00
Fax 948/ 298500
Apartado, 4209
31080 PAMPLONA (España)

Doña PURIFICACIÓN DE CASTRO LORENZO, Doctora en Medicina, Secretaria de la Comisión de Ética de Investigación de la Clínica Universitaria de la Facultad de Medicina de la Universidad de Navarra.

CERTIFICA: que, en la sesión ordinaria celebrada el día 3 de febrero de 2005, la Comisión examinó los aspectos éticos del proyecto 22/2005, presentado por Dña. Cristina Oroviogoicoechea, titulado:

"Evaluación del uso de los sistemas de información en la práctica clínica desde la perspectiva de la enfermera."

Después de comprobar el interés del estudio y de considerar que la investigadora principal ha seguido las indicaciones de la Comisión, referentes a la inclusión de una hoja de información en la que se explique el proyecto a las enfermeras a las que se va a realizar la encuesta, se decide aprobarlo.

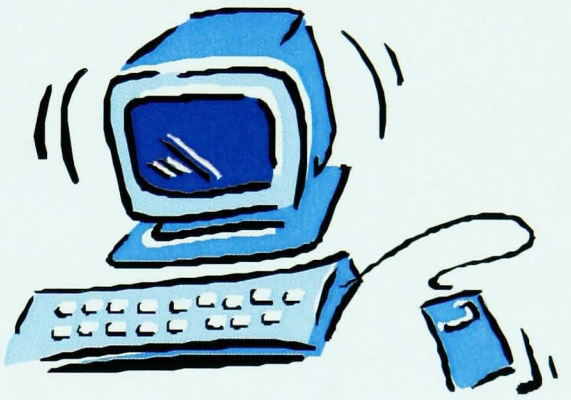
Y para que así conste, expide el presente certificado en Pamplona, a veintitres de junio de dos mil cinco.

Purificación de Castro
Secretaria

APPENDIX 2

Final draft of the questionnaire used in the pilot test

"EVALUATION OF THE USE OF A COMPUTERISED PROGRAM IN CLINICAL PRACTICE FROM THE NURSE PERSPECTIVE"



INSTRUCTIONS

- This questionnaire intends to identify the perception of nurses about the use of the computerised program  in clinical practice.
- We would be grateful if you complete this questionnaire and hand it over to the reference person who is in the room with you.
- For the validity of the study, it is very important to know your personal opinion and, therefore, we need that you answer all and each one of the questions.
- Is you have any doubt, before answering the question, ask always the reference person who is in the room with you.
- All the information is confidential. The dissemination of results will not include any reference that could identify you.

Before you continue, please, identify the ward you are working on:

SECTION A: Development of the program and support of users

1. **The following statements refer to your perception of the development of the program and support that you receive for its use. Indicate, please, your degree of agreement with each one:**

	Totally agree	Agree	Don't know	Disagree	Totally disagree
I have received adequate training for the use of information system	**1**	**2**	**3**	**4**	**5**
The attitude of the personnel in the department of informatics is co-operative	**1**	**2**	**3**	**4**	**5**
The relationship with the personnel in the department of informatics is good	**1**	**2**	**3**	**4**	**5**
The people responsible for developing the program understand my problems	**1**	**2**	**3**	**4**	**5**
The suggestions I make are taken into account	**1**	**2**	**3**	**4**	**5**
The response time to the introduction of an improvement is adequate	**1**	**2**	**3**	**4**	**5**
The changes introduced have relevance for my daily work	**1**	**2**	**3**	**4**	**5**

2. **Do you believe you need more training for the proper use of the programme?**
   ☐ No ☐ Yes

3. **If you answer yes, indicate in which aspect you believe that you need more training:**
   ☐ Test request
   ☐ Information search from previous admissions
   ☐ Access to tests results
   ☐ Nursing record
   ☐ Pharmacy
   ☐ Other (please specify)

4. **When new applications or changes in the programme are introduced, how would you evaluate**:

	Totally adequate	Adequate	Indifferent	Inadequate	Totally inadequate
Communication and information on the changes and applications that are introduced	**1**	**2**	**3**	**4**	**5**
Training to incorporate the changes and applications that are introduced	**1**	**2**	**3**	**4**	**5**
Support when problems arise during the first days of use	**1**	**2**	**3**	**4**	**5**

5. **Indicate any suggestion for the next time that a change will be introduced:**

6. **When staff of the unit talk about improvements in the program we pass on them through (indicate the most frequent one):**
   - ☐ Supervisor
   - ☐ Department of informatics
   - ☐ Help desk
   - ☐ Elena Beortegui
   - ☐ Nobody
   - ☐ Other (specify)

7. **If you have not done any suggestion to improve the program, indicate the reason:**
   - ☐ I can't think of any
   - ☐ I don't have time
   - ☐ I don't know how to do it
   - ☐ It is not my responsibility
   - ☐ It is pointless
   - ☐ Other (specify)

SECTION B: Characteristics of the running of the program

8. **The following statements refer to your perception of characteristics of the running of the programme. Indicate, please, your degree of agreement with each one:**

	Totally agree	Agree	Don't know	Disagree	Totally disagree
It is easy to learn how to use it	**1**	**2**	**3**	**4**	**5**
It is easy to use	**1**	**2**	**3**	**4**	**5**
It is easy to find the information you need (test results, reports, etc)	**1**	**2**	**3**	**4**	**5**
It is easy to know how to do what you need to do (request of test, record, etc.)	**1**	**2**	**3**	**4**	**5**
The program does not have unexpected interruptions	**1**	**2**	**3**	**4**	**5**
The program is quick	**1**	**2**	**3**	**4**	**5**

9. **Mark from 1 al 10 (from smaller to greater) your degree of competence in the use of the program** _____

10. **Order the following items according to the influence they have had in your confidence in the use of the program, 1 being the one that more positively has influenced**:

___ Training
___ Easiness of use
___ Elena Beortegui
___ Time/familiarity with the program
___ Colleagues
___ Others (specify)

11. **Indicate the frequency with which you have had problems in the use of the program during the last month:**

☐ Several times a day
☐ Once a day
☐ Several times a week
☐ Once a week
☐ Less than once a week

12. **When you face a problem, who you would turn to ask with more frequency:**

☐ Colleagues
☐ Supervisor
☐ Elena Beortegui
☐ Help desk
☐ Others (specify)

13. **What do you think are the most significant problems with the use of the program?**

14. **What do you think are the most positive aspects about the use of the program?**

15. **Indicate, please, your opinion on aspects related to the confidentiality of the program:**

    a. The program assures the confidentiality of the patient data

    ☐ Yes ☐ No ☐ Don't know

    b. The organisation has systems that ensure the adequate use of the program to guarantee confidentiality

    ☐ Yes ☐ No ☐ Don't know

    c. I have confidence that nobody can use the program with my name (user and password)

    ☐ Yes ☐ No ☐ Don't know

SECTION C: Adaptation of the program to daily work of the unit

16. **The following statements refer to your perception of the adaptation of the program to your daily work. Indicate, please, your degree of agreement with each one** :

	Totally agree	Agree	Don't know	Disagree	Totally disagree
The program is integrated into daily work	**1**	**2**	**3**	**4**	**5**
The information I access from the program makes my work easier	**1**	**2**	**3**	**4**	**5**
The program improve the quality of work	**1**	**2**	**3**	**4**	**5**
I have access to information where I need it	**1**	**2**	**3**	**4**	**5**
I have access to information when I need it	**1**	**2**	**3**	**4**	**5**
The number of computers is adequate	**1**	**2**	**3**	**4**	**5**

17. **If you have worked previously with the paper record in CUN, do you believe that the introduction of technology has changed the routines of the unit?** ☐ Yes ☐ No **. If you answer yes give an example:**

18. **Do you register and look for the information of the patient along the shift directly in the computer?** ☐ Yes ☐ No **. If no, what alternative systems do you use and why?**

19. **When you arrive to the shift, how do you obtain the information about the patients? Describe the process you follow**

SECTION D: Quality of the documentation

20. **Indicate three aims for a good documentation of the clinical history of the patient**

    1.....

    2.....

    3.....

21. **How do you think that the use of a computer program can help to achieve each one?**

    Aim 1 ☐ Contributes a lot ☐ Contributes ☐ No difference ☐ Makes it difficult ☐ Make it much difficult

    Aim 2 ☐ Contributes a lot ☐ Contributes ☐ No difference ☐ Makes it difficult ☐ Make it much difficult

    Aim 3 ☐ Contributes a lot ☐ Contributes ☐ No difference ☐ Makes it difficult ☐ Make it much difficult

22. **Indicate three barriers to achieve a good documentation of the history of the patient**

    1.....

    2.....

    3.....

23. **How do you think that the use of a computer program can affect each one?**

    Barrier 1

    ☐ Decreases a lot ☐ Decreases ☐ Don't affect ☐ Increases ☐ Increases a lot

    Barrier 2

    ☐ Decreases a lot ☐ Decreases ☐ Don't affect ☐ Increases ☐ Increases a lot

    Barrier 3

    ☐ Decreases a lot ☐ Decreases ☐ Don't affect ☐ Increases ☐ Increases a lot

24. **The following statements refer to your perception of the characteristics of information of the program in general. Indicate, please, your degree of agreement with each one**

	Totally agree	Agree	Don't know	Disagree	Totally disagree
I find all the information I need	**1**	**2**	**3**	**4**	**5**
Information is comprehensive	**1**	**2**	**3**	**4**	**5**
Information is always updated	**1**	**2**	**3**	**4**	**5**
Data I register are important for the care of the patients	**1**	**2**	**3**	**4**	**5**
Time I use for documentation is acceptable	**1**	**2**	**3**	**4**	**5**
I am certain about the reliability of the data documented	**1**	**2**	**3**	**4**	**5**

25. **Mark your satisfaction with the quality of the information of the nursing record**:

	Very good	Good	Indifferent	Bad	Very bad
Patient assessment	**1**	**2**	**3**	**4**	**5**
Care plan	**1**	**2**	**3**	**4**	**5**
Shift report	**1**	**2**	**3**	**4**	**5**
Fluids and fluid balance	**1**	**2**	**3**	**4**	**5**
Vital sign and variables	**1**	**2**	**3**	**4**	**5**
Test and procedures plan	**1**	**2**	**3**	**4**	**5**

26. **Do you think that, just with the information that the computer program provides you with, you have a complete picture of the profile of the patient?** ☐ Yes ☐ No **. In negative case, why?**

27. **Please, give some examples of**:

    a. Data you have to register that you consider unnecessary

    b. Data you have to repeat in different places

    c. Data you would like to register and there is no a defined place to do it

SECTION E: Outcomes of the use of the program

28. **Indicate the impact that you think the program has on:**

	Very positive	Positive	Indifferent	Negative	Very negative
Communication with the health team	**1**	**2**	**3**	**4**	**5**
Communication within the nursing team	**1**	**2**	**3**	**4**	**5**
Facilitation of patient care	**1**	**2**	**3**	**4**	**5**
Continuity of patient care	**1**	**2**	**3**	**4**	**5**
Co-ordination of patient care	**1**	**2**	**3**	**4**	**5**
Achievement of individualised care	**1**	**2**	**3**	**4**	**5**
Quality of information	**1**	**2**	**3**	**4**	**5**
Facilitating decision-making	**1**	**2**	**3**	**4**	**5**
Consideration of nursing work	**1**	**2**	**3**	**4**	**5**
Research development	**1**	**2**	**3**	**4**	**5**
Image of CUN	**1**	**2**	**3**	**4**	**5**

Give the reason for the one you have considered the most negative

And for the one most positive

29. **The program makes my work (underline what you consider correct in each statement)**
    a. More difficult/easier,
    b. More stressful/less stressful

30. **If you would have to go to work to a hospital with paper record, what do you think you would gain?**

31. **And, what would you lose?**

32. **If you would have the opportunity to go back to the paper record or to introduce a paper record, would you do it?** ☐ Yes ☐ No ☐ Don't know **Why?**

33. **Give an overall value from 1 to 10 (satisfied to unsatisfied) of your satisfaction with the use of the program in daily work** _____

SECTION F: Last section

34. **Please indicate the range to which your age corresponds**

☐ < 25 years
☐ 26-30
☐ 31-35
☐ 36-40
☐ 41-45
☐ 46-50
☐ >51

35. **In which year did you finish your nursing studies?**

36. **Years working as a nurse**

37. **If you start working in CUN after 2002, indicate the amount of time working in the CUN** _____

38. **Have you been working in CUN with the paper record?** ☐ Yes ☐ No

39. **Indicate since year 2002**:

a. Number of times absent for more than 2 months _____
b. Overall time of absence in months (approximately) _____
c. Time working as part-time (months) _____
d. Changes of nursing unit: None ☐ Occasionally ☐ Frequently ☐

40. **How do you define your attitude towards the introduction of technology in society?**

☐ positive
☐ negative
☐ indifferent

41. **Do you have computer at home?** ☐ Yes ☐ No

42. **What for do you use of the computer apart from work?**

☐ internet
☐ mail
☐ others (specify)

43. **Give an overall value from 1 to 10 (from minor to major) of your ability with the use of computers**_____

Finally, if you want to make any further comment related to the use of the computerised program in daily work, you can do it in the space below:

THANK YOU!

APPENDIX 3

Nurses letter to invite them to participate in the study

Estimada ,

El motivo de esta carta es informarte y pedir tu colaboración en un proyecto de investigación que se va a realizar en la CUN como parte de una tesis doctoral. En este proyecto contamos con la colaboración de Roger Watson, supervisor principal del estudio y profesor de la Univesidad de Hull (Reino Unido), que cuenta con una amplia experiencia investigadora.

El objetivo general es realizar una evaluación del uso de los sistemas de información en la práctica clínica en la Clínica Universitaria desde la perspectiva de la enfermera. Los resultados contribuirán a disponer de un estudio en profundidad del uso de los sistemas de información dirigido a los mecanismos causales, como y por qué facilitan o no la práctica clínica. Estos apoyaran el desarrollo eficiente e implantación de sistemas de información como una contribución positiva y un apoyo real a la práctica clínica.

Tu opinión como enfermera es fundamental para este estudio y para ello hemos elaborado un cuestionario que nos gustaría que completases. Todos los datos obtenidos serán tratados confidencialmente. Para facilitar su cumplimentación se realizarán distintas sesiones a las que puedes acudir si quieres participar y en las que previamente se proporcionará toda la información necesaria acerca del proyecto. Las fechas, horas y lugar de las sesiones se informarán con la antelación suficiente y se programarán para facilitar tu asistencia. Si por algún motivo no puedes asistir a ninguna sesión y tienes interés en participar, puedes ponerte en contacto directamente conmigo o comunicárselo a la supervisora.

No existe ninguna obligación de participar, pero que duda cabe que este estudio no sería posible sin tu colaboración. Si deseas más información no dudes en ponerte en contacto conmigo.

Agradeciendo de antemano tu colaboración.

Atentamente,

Cristina Oroviogoicoechea
Ext 2118
Busca 155

(Translation)

Dear ,

The purpose of this letter is to inform you and ask for your collaboration in a research project that is going to be carried out in the hospital as part of a thesis. In this project we count on the collaboration of Roger Watson, supervisor of the thesis and Professor of the University of Hull (United Kingdom), who has a large research experience.

The general aim of the research is to evaluate the use of the information systems in clinical practice in the hospital from the nurses' perspective. The results will contribute to provide an in-depth analysis of the use of information systems, looking at causal mechanisms, how and why they enhance or not clinical practice. The results will support efficient development and implementation of clinical information systems as a positive contribution and support of clinical practice.

Your opinion as a nurse is essential for the study and we have elaborated a questionnaire that we would like you to complete. All data obtained will be treated as confidential. To facilitate completion of the questionnaire, we have organised different sessions that you can attend if you want to participate and we will provide you with all the information needed in relation to the research project. The dates, timetable and places of the sessions will be announced with plenty of time and they will be planned to facilitate your attendance. If for any reason you cannot attend any of the sessions and you are interested in participating, you can contact me or ask to your ward manager.

There is no obligation to participate, but there is absolutely no doubt about that this research would not be possible without your collaboration. If you would like more information do not hesitate to contact me.

Thank you in advance for your collaboration.

Yours sincerely,

Cristina Oroviogoicoechea
Ext 2118
Busca 155

APPENDIX 4

Final version of the questionnaire

"EVALUATION OF THE USE OF A COMPUTERISED PROGRAM IN CLINICAL PRACTICE FROM THE NURSE PERSPECTIVE"

INSTRUCTIONS

- This questionnaire intends to identify the perception of nurses about the use of the computerised program  in clinical practice.
- We would be grateful if you complete this questionnaire and hand it over to the reference person who is in the room with you.
- For the validity of the study, it is very important to know your personal opinion and, therefore, we need that you answer <u>all and each one of the questions</u>.
- Is you have any doubt, before answering the question, <u>ask always</u> the reference person who is in the room with you.
- All the information is <u>confidential</u>. The dissemination of results will not include any reference that could identify you.

Before you continue, please, identify the ward you are working on:

SECTION A: Development of the program and support of users

1. **The following statements refer to your perception of the development of the program and support that you receive for its use. Indicate, please, your degree of agreement with each one:**

	Totally agree	Agree	Don't know	Disagree	Totally disagree
I have received adequate training for the use of information system	**1**	**2**	**3**	**4**	**5**
The attitude of the personnel in the department of informatics is co-operative	**1**	**2**	**3**	**4**	**5**
The relationship with the personnel in the department of informatics is good	**1**	**2**	**3**	**4**	**5**
The people responsible for developing the program understand my problems	**1**	**2**	**3**	**4**	**5**
The suggestions I make are taken into account	**1**	**2**	**3**	**4**	**5**
The response time to the introduction of an improvement is adequate	**1**	**2**	**3**	**4**	**5**
The changes introduced have relevance for my daily work	**1**	**2**	**3**	**4**	**5**

2. **Do you believe you need more training for the proper use of the programme?**
   ☐ Yes ☐ No

3. **If you answer yes, indicate in which aspect you believe that you need more training:**
   ☐ Test request
   ☐ Information search from previous admissions
   ☐ Access to tests results
   ☐ Nursing record
   ☐ Pharmacy
   ☐ Other (please specify)

4. **When new applications or changes in the programme are introduced, how would you evaluate:**

	Totally adequate	Adequate	Indifferent	Inadequate	Totally inadequate
Communication and information on the changes and applications that are introduced	**1**	**2**	**3**	**4**	**5**
Training to incorporate the changes and applications that are introduced	**1**	**2**	**3**	**4**	**5**
Support when problems arise during the first days of use	**1**	**2**	**3**	**4**	**5**

5. **Indicate any suggestion for the next time that a change will be introduced:**

6. **When staff of the unit talk about improvements in the program we pass on them through (indicate the most frequent one):**
   - ☐ Supervisor
   - ☐ Department of informatics
   - ☐ Help desk
   - ☐ Elena Beortegui
   - ☐ Nobody
   - ☐ Other (specify)

7. **Have you have made any suggestions for improvements in the last 3 months?**
   - ☐ Yes ☐ No

8. **If no, indicate the reason:**
   - ☐ I can't think of any
   - ☐ I don't have time
   - ☐ I don't know how to do it
   - ☐ It is not my responsibility
   - ☐ It is pointless
   - ☐ Other (specify)

SECTION B: Characteristics of the running of the program

9. **The following statements refer to your perception of characteristics of the running of the programme. Indicate, please, your degree of agreement with each one:**

	Totally agree	Agree	Don't know	Disagree	Totally disagree
It is easy to learn how to use it	**1**	**2**	**3**	**4**	**5**
It is easy to use	**1**	**2**	**3**	**4**	**5**
It is easy to find the information you need (test results, reports, etc)	**1**	**2**	**3**	**4**	**5**
It is easy to know how to do what you need to do (request of test, record, etc.)	**1**	**2**	**3**	**4**	**5**
The program does not have unexpected interruptions	**1**	**2**	**3**	**4**	**5**
The program is quick	**1**	**2**	**3**	**4**	**5**

10. **Mark from 1 al 10 (from smaller to greater) your degree of competence in the use of the program** _____

11. **Order the following items according to the influence they have had in your confidence in the use of the program, 1 being the one that more positively has influenced**:

___ Training
___ Easiness of use
___ Elena Beortegui
___ Time/familiarity with the program
___ Colleagues
___ Others (specify)

12. **Indicate the frequency with which you have had problems in the use of the program during the last month:**

☐ Several times a day
☐ Once a day
☐ Several times a week
☐ Once a week
☐ Less than once a week

13. **Having in mind the problems that you regularly have, indicate who you would turn to try to resolve them with more frequency:**

☐ Colleagues
☐ Supervisor
☐ Elena Beortegui
☐ Help desk
☐ Others (specify)

14. **What do you think are the most significant problems with the use of the program?**

15. **What do you think are the most positive aspects about the use of the program?**

16. **Indicate, please, your opinion on aspects related to the confidentiality of the program:**

a. The program assures the confidentiality of the patient data

☐ Yes ☐ No ☐ Don't know

b. The organisation has systems that ensure the adequate use of the program to guarantee confidentiality

☐ Yes ☐ No ☐ Don't know

c. I have confidence that nobody can use the program with my name (user and password)

☐ Yes ☐ No ☐ Don't know

Add, if you think necessary, any comments about confidentiality:

SECTION C: Adaptation of the program to daily work of the unit

17. **The following statements refer to your perception of the adaptation of the program to your daily work. Indicate, please, your degree of agreement with each one** :

	Totally agree	Agree	Don't know	Disagree	Totally disagree
The program is integrated into daily work	**1**	**2**	**3**	**4**	**5**
The information I access from the program makes my work easier	**1**	**2**	**3**	**4**	**5**
The program improve the quality of work	**1**	**2**	**3**	**4**	**5**
I have access to information where I need it	**1**	**2**	**3**	**4**	**5**
I have access to information when I need it	**1**	**2**	**3**	**4**	**5**
The number of computers is adequate	**1**	**2**	**3**	**4**	**5**

18. **If you have worked previously with the nursing paper record in CUN, do you believe that informatización has changed the routines of the unit?** ☐ Yes ☐ No **. If you answer yes give an example:**

19. **Do you register and look for the information of the patient along the shift directly in the computer?** ☐ Yes ☐ No **. If no, what alternative systems do you use and why?**

20. **When you arrive to the shift, how do you obtain the information about the patients? Describe the process you follow**

SECTION D: Quality of the documentation

21. **Why do you think it is necessary to achieve a good documentation of the clinical history of the patient?**

22. **How do you think that the use of a computer program can help to achieve it?**

23. **What barriers exist to achieving a good documentation of the history of the patient? (Indicate a maximum of 3)**

    1.....

    2.....

    3.....

24. **How do you think that the use of a computer program can affect each one?**

    Barrier 1

    ☐ Decreases a lot ☐ Decreases ☐ Don't affect ☐ Increases ☐ Increases a lot

    Barrier 2

    ☐ Decreases a lot ☐ Decreases ☐ Don't affect ☐ Increases ☐ Increases a lot

    Barrier 3

    ☐ Decreases a lot ☐ Decreases ☐ Don't affect ☐ Increases ☐ Increases a lot

25. **The following statements refer to your perception of the characteristics of information of the program in general. Indicate, please, your degree of agreement with each one**

	Totally agree	Agree	Don't know	Disagree	Totally disagree
I find all the information I need	**1**	**2**	**3**	**4**	**5**
Information is comprehensive	**1**	**2**	**3**	**4**	**5**
Information is always updated	**1**	**2**	**3**	**4**	**5**
Data I register are important for the care of the patients	**1**	**2**	**3**	**4**	**5**
Time I use for documentation is acceptable	**1**	**2**	**3**	**4**	**5**
I am certain about the reliability of the data documented	**1**	**2**	**3**	**4**	**5**

26. **Mark your satisfaction with the quality of the information of the nursing record**:

	Very good	Good	Indifferent	Bad	Very bad
Patient assessment	**1**	**2**	**3**	**4**	**5**
Care plan	**1**	**2**	**3**	**4**	**5**
Shift report	**1**	**2**	**3**	**4**	**5**
Fluids and fluid balance	**1**	**2**	**3**	**4**	**5**
Vital sign and variables	**1**	**2**	**3**	**4**	**5**
Test and procedures plan	**1**	**2**	**3**	**4**	**5**

27. **Do you think that, just with the information that the computer program provides you with, you have a complete picture of the profile of the patient?** ☐ Yes ☐ No **. In negative case, why?**

28. **Please, give some examples of**:

a. Data you have to register that you consider unnecessary

b. Data you have to repeat in different places

c. Data you would like to register and there is no a defined place to do it

SECTION E: Outcomes of the use of the program

29. **Indicate the impact that you think the program has on:**

	Very positive	Positive	Indifferent	Negative	Very negative
Communication with the health team	**1**	**2**	**3**	**4**	**5**
Communication within the nursing team	**1**	**2**	**3**	**4**	**5**
Facilitation of patient care	**1**	**2**	**3**	**4**	**5**
Continuity of patient care	**1**	**2**	**3**	**4**	**5**
Co-ordination of patient care	**1**	**2**	**3**	**4**	**5**
Achievement of individualised care	**1**	**2**	**3**	**4**	**5**
Quality of information	**1**	**2**	**3**	**4**	**5**
Facilitating decision-making	**1**	**2**	**3**	**4**	**5**
Consideration of nursing work	**1**	**2**	**3**	**4**	**5**
Research development	**1**	**2**	**3**	**4**	**5**
Image of CUN	**1**	**2**	**3**	**4**	**5**

Give the reason for the one you have considered the most negative

And for the one most positive

30. **The program makes my work (underline what you consider correct in each statement)**
    a. More difficult/easier,
    b. More stressful/less stressful

31. **If you would have to go to work to a hospital with paper record, what do you think you would gain and lose?**

32. **If you would have the opportunity to go back to the paper record or to introduce a paper record, would you do it?** ☐ Yes ☐ No ☐ Don't know **Why?**

33. **Give an overall value from 1 to 10 (satisfied to unsatisfied) of your satisfaction with the use of the program in daily work** _____

SECTION F: Last section

34. **Please indicate the range to which your age corresponds**

☐ < 25 years
☐ 26-30
☐ 31-35
☐ 36-40
☐ 41-45
☐ 46-50
☐ >51

35. **In which year did you finish your nursing studies?**

36. **Years working as a nurse**

37. **If you start working in CUN after 2002, indicate the amount of time working in the CUN** _____

38. **Have you been working in CUN with the paper record?** ☐ Yes ☐ No

39. **Indicate since year 2002**:
    a. Number of times absent for more than 2 months _____
    b. Overall time of absence in months (approximately) _____
    c. Time working as part-time (months) _____
    d. Changes of nursing unit: None ☐ Occasionally ☐ Frequently ☐

40. **How do you define your attitude towards the introduction of technology in society?**
    ☐ positive
    ☐ negative
    ☐ indifferent

41. **Do you have computer at home?** ☐ Yes ☐ No

42. **What for do you use of the computer apart from work?**
    ☐ internet
    ☐ mail
    ☐ others (specify)

43. **Give an overall value from 1 to 10 (from minor to major) of your ability with the use of computers**_____

Finally, if you want to make any further comment related to the use of the computerised program in daily work, you can do it in the space below:

THANK YOU!

APPENDIX 5

Ward managers letter

Estimada,

El motivo de esta carta es informarte y pedir tu colaboración en un proyecto de investigación que voy a realizar en la CUN como parte de la tesis doctoral. En este proyecto cuento con la colaboración de Roger Watson, supervisor principal del estudio y profesor de la Univesidad de Hull (Reino Unido), que cuenta con una amplia experiencia investigadora.

El objetivo general es realizar una evaluación del uso de los sistemas de información en la práctica clínica en la Clínica Universitaria desde la perspectiva de la enfermera. Los resultados contribuirán a disponer de un estudio en profundidad del uso de los sistemas de información dirigido a los mecanismos causales, como y por qué facilitan o no la práctica clínica. Estos apoyaran el desarrollo eficiente e implantación de sistemas de información como una contribución positiva y un apoyo real a la práctica clínica.

La opinión de las enfermeras es fundamental para este estudio y para ello hemos elaborado un cuestionario que nos gustaría que completasen. Para facilitar la cumplimentación del cuestionario se realizarán distintas sesiones en las que previamente se proporcionará toda la información necesaria acerca del proyecto Todos los datos obtenidos serán tratados confidencialmente. Se les ha enviado una carta personal a cada una explicándoles en qué consiste el proyecto y pidiendo su participación.

Tu colaboración en este proceso consiste en animarles a participar y facilitarles la asistencia a alguna de las sesiones organizadas. Te adjunto las fechas y horas de las distintas sesiones. Si por algún motivo alguna enfermera no puede asistir a ninguna sesión y tiene interés en participar, no dejes de comunicármelo para ver la forma de facilitárselo.

No existe ninguna obligación de participar, pero que duda cabe que este estudio no sería posible sin la participación de las enfermeras y tu ayuda para animarles a hacerlo. Si deseas más información no dudes en ponerte en contacto conmigo.

Agradeciendo de antemano tu colaboración.

Atentamente,

Cristina Oroviogoicoechea
Ext 2118
Busca 155

(translation)

Dear,

The purpose of this letter is to inform you and ask for your collaboration in a research project that is going to be carried out in the hospital as part of a thesis. In this project we count on the collaboration of Roger Watson, supervisor of the thesis and Professor of the University of Hull (United Kingdom), who has a large research experience.

The general aim of the research is to evaluate the use of the information systems in clinical practice in the hospital from the nurses' perspective. The results will contribute to provide an in-depth analysis of the use of information systems looking at causal mechanisms, how and why they enhance or not clinical practice. The results will support efficient development and implementation of clinical information systems as a positive contribution and support of clinical practice.

Nurses' opinion is essential for the study and we have elaborated a questionnaire that we would like them to complete. To facilitate completion of the questionnaire, we have organised different sessions they can attend to answer the questionnaire and we will provide them with all the information needed in relation to the research project. All data obtained will be treated as confidential. A personal letter has been sent to every nurse explaining the study and inviting them to participate.

Your collaboration in this process consists of encouraging them to participate and facilitating their attendance to any of the organised sessions. I attach the dates and timetable of the different sessions. If, for any reason, a nurse cannot attend any of the sessions and she is interested in participating, do not hesitate to contact me to see how we can facilitate it.

Thank you in advanced for your collaboration.

Yours sincerely,

Cristina Oroviogoicoechea
Ext 2118
Busca 155

APPENDIX 6

Bonferroni post-hoc test results of individual units differences in relation to IT support

Dependent variable	(I) Unit	(J) Unit	Mean difference (I-J)	Standard Error	Sig.	95%Confidence interval	
						Lower bound	Upper bound
IT support	J	K	,02412	,15179	1,000	-,4973	,5455
		L	-,23421	,17477	1,000	-,8346	,3662
		I	-,12469	,15756	1,000	-,6659	,4166
		H	-,16754	,17477	1,000	-,7679	,4328
		F	-,13421	,17477	1,000	-,7346	,4662
		G	-,10643	,15451	1,000	-,6372	,4243
		E	,02412	,18854	1,000	-,6235	,6718
		D	-,35088	,14714	1,000	-,8563	,1546
		C	,12690	,15451	1,000	-,4039	,6577
		A	-,67780(*)	,13501	,000	-1,1416	-,2140
		B	-,01754	,18854	1,000	-,6652	,6301
	K	J	-,02412	,15179	1,000	-,5455	,4973
		L	-,25833	,18033	1,000	-,8778	,3611
		I	-,14881	,16371	1,000	-,7112	,4136
		H	-,19167	,18033	1,000	-,8111	,4278
		F	-,15833	,18033	1,000	-,7778	,4611
		G	-,13056	,16077	1,000	-,6828	,4217
		E	,00000	,19370	1,000	-,6654	,6654
		D	-,37500	,15370	1,000	-,9030	,1530
		C	,10278	,16077	1,000	-,4495	,6551
		A	-,70192(*)	,14214	,000	-1,1902	-,2136
		B	-,04167	,19370	1,000	-,7071	,6237
	L	J	,23421	,17477	1,000	-,3662	,8346
		K	,25833	,18033	1,000	-,3611	,8778
		I	,10952	,18522	1,000	-,5267	,7458
		H	,06667	,20006	1,000	-,6206	,7539
		F	,10000	,20006	1,000	-,5872	,7872
		G	,12778	,18263	1,000	-,4996	,7551
		E	,25833	,21219	1,000	-,4706	,9873
		D	-,11667	,17643	1,000	-,7228	,4894
		C	,36111	,18263	1,000	-,2662	,9885
		A	-,44359	,16646	,561	-1,0154	,1282
		B	,21667	,21219	1,000	-,5123	,9456

* p<0.05; Unit A: ICU

(Continued)

Dependent variable	(I) Unit	(J) Unit	Mean difference (I-J)	Standard error	Sig.	95% confidence interval	
						Lower bound	Upper bound
IT support	I	J	,12469	,15756	1,000	-,4166	,6659
		K	,14881	,16371	1,000	-,4136	,7112
		L	-,10952	,18522	1,000	-,7458	,5267
		H	-,04286	,18522	1,000	-,6791	,5934
		F	-,00952	,18522	1,000	-,6458	,6267
		G	,01825	,16624	1,000	-,5528	,5893
		E	,14881	,19826	1,000	-,5323	,8299
		D	-,22619	,15941	1,000	-,7738	,3214
		C	,25159	,16624	1,000	-,3195	,8226
		A	-,55311(*)	,14829	,018	-1,0625	-,0437
		B	,10714	,19826	1,000	-,5739	,7882
	H	J	,16754	,17477	1,000	-,4328	,7679
		K	,19167	,18033	1,000	-,4278	,8111
		L	-,06667	,20006	1,000	-,7539	,6206
		I	,04286	,18522	1,000	-,5934	,6791
		F	,03333	,20006	1,000	-,6539	,7206
		G	,06111	,18263	1,000	-,5662	,6885
		E	,19167	,21219	1,000	-,5373	,9206
		D	-,18333	,17643	1,000	-,7894	,4228
		C	,29444	,18263	1,000	-,3329	,9218
		A	-,51026	,16646	,169	-1,0821	,0616
		B	,15000	,21219	1,000	-,5789	,8789
	F	J	,13421	,17477	1,000	-,4662	,7346
		K	,15833	,18033	1,000	-,4611	,7778
		L	-,10000	,20006	1,000	-,7872	,5872
		I	,00952	,18522	1,000	-,6267	,6458
		H	-,03333	,20006	1,000	-,7206	,6539
		G	,02778	,18263	1,000	-,5996	,6551
		E	,15833	,21219	1,000	-,5706	,8873
		D	-,21667	,17643	1,000	-,8228	,3894
		C	,26111	,18263	1,000	-,3662	,8885
		A	-,54359	,16646	,089	-1,1154	,0282
		B	,11667	,21219	1,000	-,6123	,8456
	G	J	,10643	,15451	1,000	-,4243	,6372
		K	,13056	,16077	1,000	-,4217	,6828
		L	-,12778	,18263	1,000	-,7551	,4996
		I	-,01825	,16624	1,000	-,5893	,5528
		H	-,06111	,18263	1,000	-,6885	,5662
		F	-,02778	,18263	1,000	-,6551	,5996
		E	,13056	,19584	1,000	-,5422	,8033
		D	-,24444	,15639	1,000	-,7817	,2928
		C	,23333	,16334	1,000	-,3278	,7945
		A	-,57137(*)	,14504	,008	-1,0696	-,0731
		B	,08889	,19584	1,000	-,5839	,7617

p<0.05; Unit A: ICU

(Continued)

Dependent variable	(I) Unit	(J) Unit	Mean difference (I-J)	Standard error	Sig.	95% confidence interval	
						Lower bound	Upper bound
IT support	E	J	-,02412	,18854	1,000	-,6718	,6235
		K	,00000	,19370	1,000	-,6654	,6654
		L	-,25833	,21219	1,000	-,9873	,4706
		I	-,14881	,19826	1,000	-,8299	,5323
		H	-,19167	,21219	1,000	-,9206	,5373
		F	-,15833	,21219	1,000	-,8873	,5706
		G	-,13056	,19584	1,000	-,8033	,5422
		D	-,37500	,19008	1,000	-1,0280	,2780
		C	,10278	,19584	1,000	-,5700	,7755
		A	-,70192(*)	,18086	,010	-1,3232	-,0806
		B	-,04167	,22367	1,000	-,8100	,7267
	D	J	,35088	,14714	1,000	-,1546	,8563
		K	,37500	,15370	1,000	-,1530	,9030
		L	,11667	,17643	1,000	-,4894	,7228
		I	,22619	,15941	1,000	-,3214	,7738
		H	,18333	,17643	1,000	-,4228	,7894
		F	,21667	,17643	1,000	-,3894	,8228
		G	,24444	,15639	1,000	-,2928	,7817
		E	,37500	,19008	1,000	-,2780	1,0280
		C	,47778	,15639	,175	-,0595	1,0150
		A	-,32692	,13716	1,000	-,7981	,1443
		B	,33333	,19008	1,000	-,3196	,9863
	C	J	-,12690	,15451	1,000	-,6577	,4039
		K	-,10278	,16077	1,000	-,6551	,4495
		L	-,36111	,18263	1,000	-,9885	,2662
		I	-,25159	,16624	1,000	-,8226	,3195
		H	-,29444	,18263	1,000	-,9218	,3329
		F	-,26111	,18263	1,000	-,8885	,3662
		G	-,23333	,16334	1,000	-,7945	,3278
		E	-,10278	,19584	1,000	-,7755	,5700
		D	-,47778	,15639	,175	-1,0150	,0595
		A	-,80470(*)	,14504	,000	-1,3030	-,3064
		B	-,14444	,19584	1,000	-,8172	,5283
	A	J	,67780(*)	,13501	,000	,2140	1,1416
		K	,70192(*)	,14214	,000	,2136	1,1902
		L	,44359	,16646	,561	-,1282	1,0154
		I	,55311(*)	,14829	,018	,0437	1,0625
		H	,51026	,16646	,169	-,0616	1,0821
		F	,54359	,16646	,089	-,0282	1,1154
		G	,57137(*)	,14504	,008	,0731	1,0696
		E	,70192(*)	,18086	,010	,0806	1,3232
		D	,32692	,13716	1,000	-,1443	,7981
		C	,80470(*)	,14504	,000	,3064	1,3030
		B	,66026(*)	,18086	,023	,0390	1,2816

*p<0.05; Unit A: ICU

(Continued)

Dependent variable	(I) Unit	(J) Unit	Mean difference (I-J)	Standard error	Sig.	95% confidence interval	
						Lower bound	Upper bound
IT support	B	J	,01754	,18854	1,000	-,6301	,6652
		K	,04167	,19370	1,000	-,6237	,7071
		L	-,21667	,21219	1,000	-,9456	,5123
		I	-,10714	,19826	1,000	-,7882	,5739
		H	-,15000	,21219	1,000	-,8789	,5789
		F	-,11667	,21219	1,000	-,8456	,6123
		G	-,08889	,19584	1,000	-,7617	,5839
		E	,04167	,22367	1,000	-,7267	,8100
		D	-,33333	,19008	1,000	-,9863	,3196
		C	,14444	,19584	1,000	-,5283	,8172
		A	-,66026(*)	,18086	,023	-1,2816	-,0390

*p<0.05; Unit A: ICU

APPENDIX 7

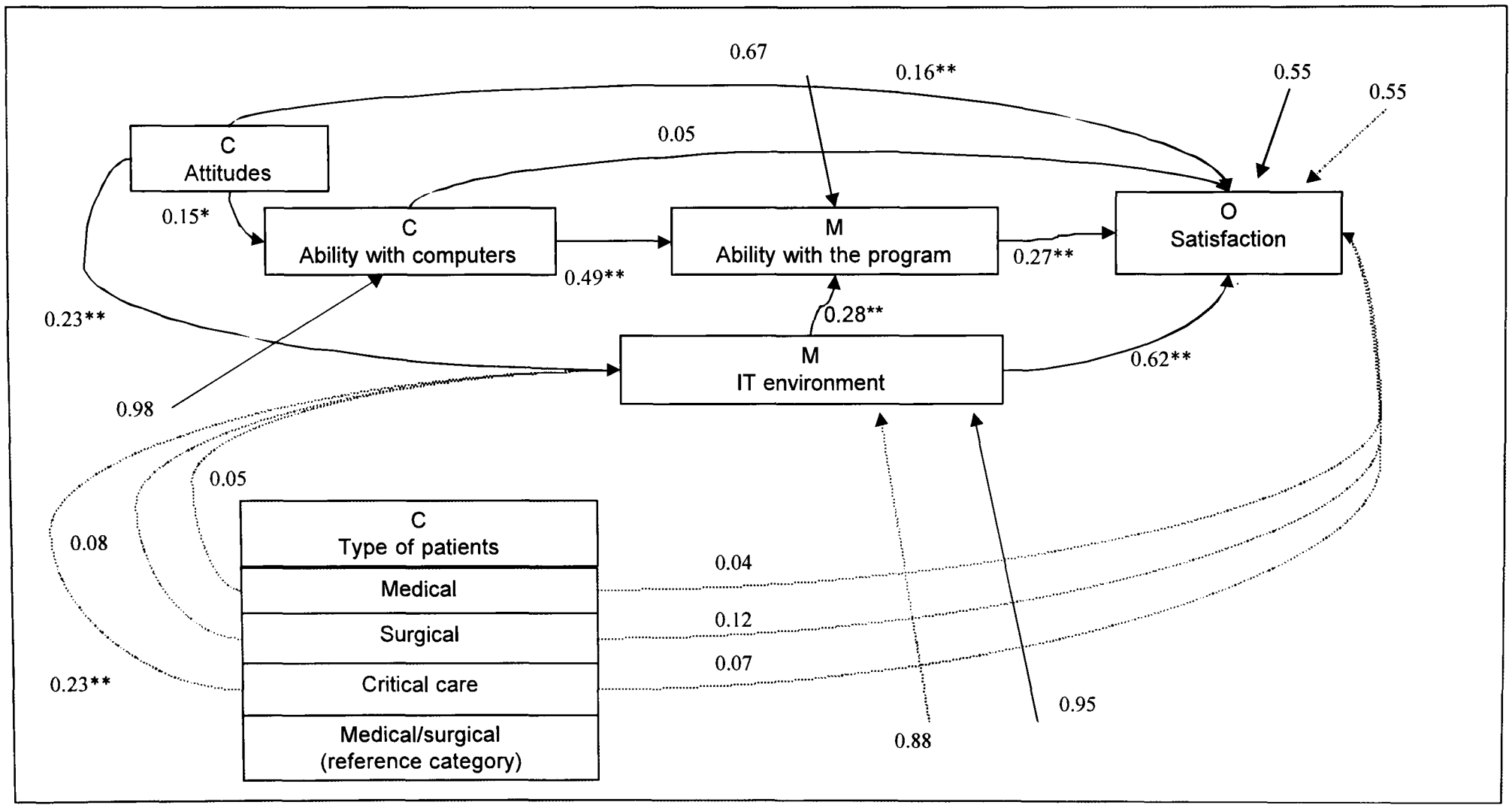
Bonferroni post-hoc test results of units' type of patients differences in relation to IT support

Dependent variable	(I) Type of patients	(J) Type of patients	Mean difference (I-J)	Standard error	Sig.	95% confidence interval	
						Lower bound	Upper bound
IT support	Surgical	Medical	-,01805	,10728	1,000	-,3045	,2684
		Medical/surgical	-,10732	,11019	1,000	-,4016	,1869
		Critical care	-,47617(*)	,11889	,001	-,7936	-,1587
	Medical	Surgical	,01805	,10728	1,000	-,2684	,3045
		Medical/surgical	-,08927	,09163	1,000	-,3340	,1554
		Critical care	-,45812(*)	,10192	,000	-,7303	-,1860
	Medical/surgical	Surgical	,10732	,11019	1,000	-,1869	,4016
		Medical	,08927	,09163	1,000	-,1554	,3340
		Critical care	-,36885(*)	,10498	,003	-,6492	-,0885
	Critical care	Surgical	,47617(*)	,11889	,001	,1587	,7936
		Medical	,45812(*)	,10192	,000	,1860	,7303
		Medical/surgical	,36885(*)	,10498	,003	,0885	,6492

* $p<0.05$

APPENDIX 8

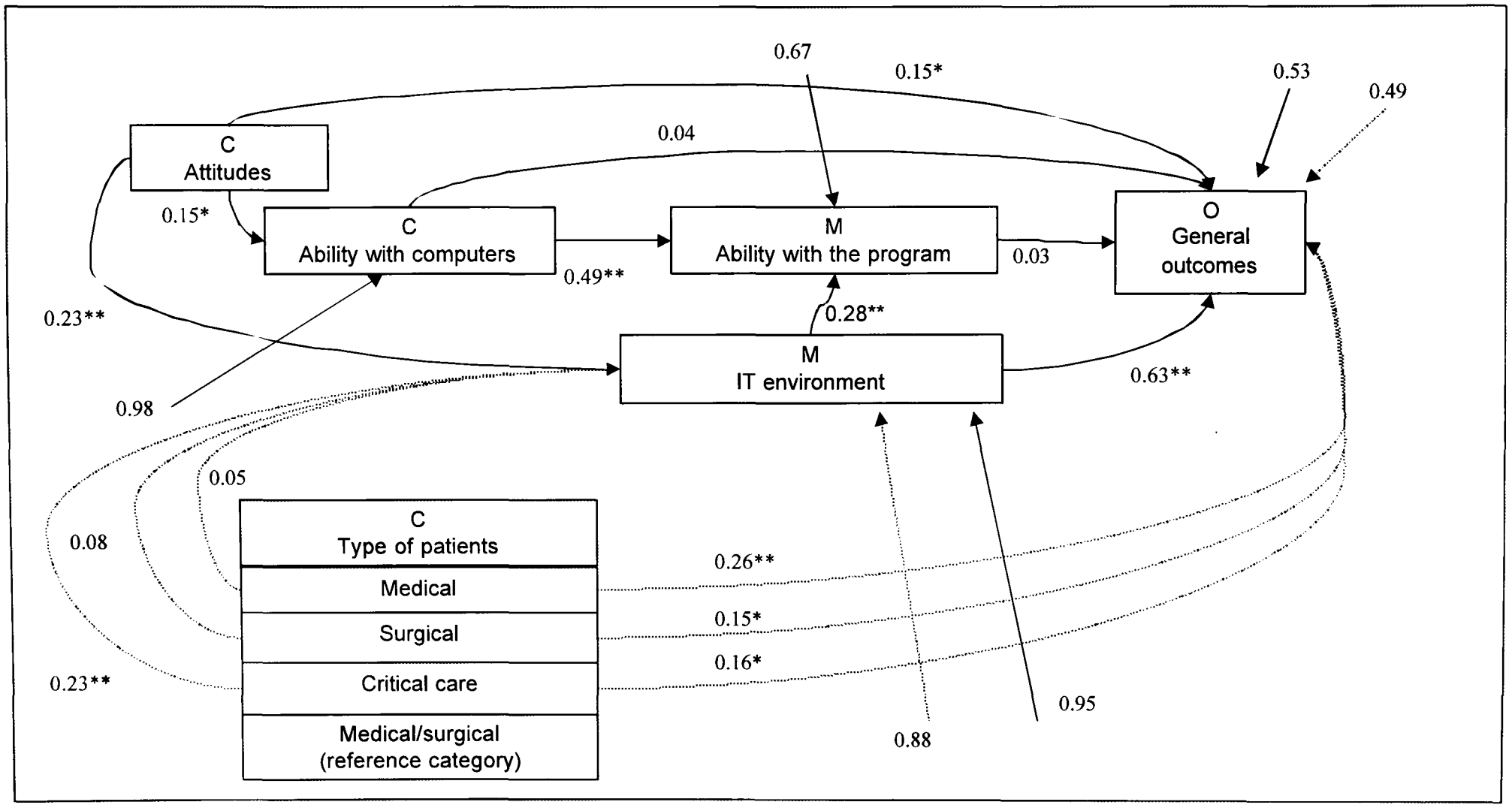
Path analysis results for satisfaction



*p= 0.05; ** p= 0.01

APPENDIX 9

Path analysis results for outcomes factors



*p= 0.05; ** p= 0.01

APPENDIX 10

Article based in the literature review published in the *Journal of Clinical Nursing*

Journal of Clinical Nursing

REVIEW

Review: evaluating information systems in nursing

Cristina Oroviogoicoechea MSc, RGN
General Nurse Manager, Clinica Universitaria, Universidad de Navarra, Pamplona, Spain

Barbara Elliott BNurs, MSc, RGN, RHV, RDN, RSCN, PGCHE
Lecturer, Faculty of Health and Social Care, University of Hull, Hull, UK

Roger Watson PhD, RN, FBiol
Professor of Nursing, School of Nursing and Midwifery, The University of Sheffield, Sheffield, UK

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Correspondence:
Barbara Elliott
University of Hull
Hull HU5 7RX
England
Telephone: +44(1)482 464518
E-mail: b.e.elliott@hull.ac.uk

OROVIOGOICOECHEA C, ELLIOTT B & WATSON R (2008) *Journal of Clinical Nursing* 17, 567–575

Review: evaluating information systems in nursing

Aims. To review existing nursing research on inpatient hospitals' information technology (IT) systems in order to explore new approaches for evaluation research on nursing informatics to guide further design and implementation of effective IT systems.

Background. There has been an increase in the use of IT and information systems in nursing in recent years. However, there has been little evaluation of these systems and little guidance on how they might be evaluated.

Methods. A literature review was conducted between 1995 and 2005 inclusive using CINAHL and Medline and the search terms 'nursing information systems', 'clinical information systems', 'hospital information systems', 'documentation', 'nursing records', 'charting'.

Results. Research in nursing information systems was analysed and some deficiencies and contradictory results were identified which impede a comprehensive understanding of effective implementation. There is a need for IT systems to be understood from a wider perspective that includes aspects related to the context where they are implemented.

Conclusions. Social and organizational aspects need to be considered in evaluation studies and realistic evaluation can provide a framework for the evaluation of information systems in nursing.

Relevance to clinical practice. The rapid introduction of IT systems for clinical practice urges evaluation of already implemented systems examining how and in what circumstances they work to guide effective further development and implementation of IT systems to enhance clinical practice. Evaluation involves more factors than just involving technologies such as changing attitudes, cultures and healthcare practices. Realistic evaluation could provide configurations of context-mechanism-outcomes that explain the underlying relationships to understand why and how a programme or intervention works.

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Key words: computers, information technology, nurses, nursing, realistic evaluation, records

Introduction

Quality of care is directly related to the quality of information available to healthcare professionals and charting and managing clinical information is an essential part of their daily work (Currel & Urquhart 2003). This is not a new idea; however, the complexity of the healthcare context, the need to demonstrate effectiveness in clinical practice and the current transformation of healthcare institutions with the introduction of informatics are some of the reasons for the considerable interest in the process of clinical information and communication during the last decade. Ability to capture data and use data is a hallmark for excellence.

'To perform their services, modern healthcare organizations are profoundly dependent on rich and accurate information collected and shared between multiple organizational levels.' (Andersson *et al.* 2003 p. 47). Information comprises a wide range of aspects including patient-specific data, research information and procedure information (Henry 1995). In this context, information technology (IT) offers tremendous opportunities to enhance clinical practice and appropriateness of care and to increase efficiency and effectiveness in healthcare organizations (Ammenwerth *et al.* 2004). Clinically oriented applications are increasingly being developed and introduced to support the daily work of healthcare professionals (Giuse & Kuhn 2003).

The current paradigm in healthcare is a multi-disciplinary approach; it is not one-individual profession, but a team, which provides comprehensive and coordinated care (Tierney 2001). Care provision is understood within a multi-disciplinary context where different professionals have a role with specific contribution and activities, but from the patient perspective provision of care is teamwork. Hence patient care depends upon complete and accurate information among caregivers within the team.

Within the information processes the patient record has a central role and nursing documentation is an important part of it (Bjorwell *et al.* 2000, Helleso & Ruland 2001). Patient records are considered the most important tool for information and communication in healthcare organizations and a key element for the continuity and coordination of patient care (Martin *et al.* 1999). Nurses within the team, because of their central role in providing 24-hour care and in coordinating the care given by the team, are recognized as 'key collectors, generators and users of patient/client information' (Currel & Urquhart 2003). Safe and high quality care may be considered as outcomes of good patient records.

Data documentation is a major issue within nursing and can be considered a devalued aspect, lacking recognition even within the profession itself. Low quality and time consuming records are reasons for nurses' low acceptance of documentation (Nahm & Poston 2000, Ammenwerth *et al.* 2001b). Nevertheless, the Nursing and Midwifery Council (NMC) in the UK (2004 p. 5) has stated, generally, that 'record keeping is a fundamental part of nursing.' The NMC (2004) has issued guidelines specific to records and record keeping and these superseded earlier guidelines in 1998 from the former United Kingdom Central Council for Nursing, Midwifery and Health Visiting. There is a tradition of oral communication for the transmission of the knowledge nurses have about patient conditions (Heartfield 1996, McDaniel 1997, Erdley 2005). Nursing documentation has been highly influenced by legal, management and professional issues, looking to a documentation that fully reflects the work of the nurses and therefore makes nursing visible. Nursing records have been developed not only for their use as vehicles for storage and exchange of information but they have also been used to support different philosophies of nursing practice (Currel & Urquhart 2003).

The development of nursing documentation has come at the same time as the introduction of the nursing process in clinical settings (Ammenwerth *et al.* 2003b). Studies refer to the difficulty for nurses in complying with the requirements of this kind of documentation and see it as taking them away from the patient. Nurse documentation has not been explored from the point of view of the nurses use of it for clinical practice although Higuchi and Donald (2002) p. 150) exploring thinking processes evidenced in nursing documentation found that 'chart data represented a summary of the nurses' thinking processes and the communication of selected information about a clinical situation. Teamwork, accountability and the need to provide evidence on nursing contribution to patient care are factors contributing to a growing nursing awareness of the relevance of nursing documentation.

It is widely recognized that paper-records do not meet the requirements of today's healthcare institutions (van Ginneken 2002). IT can help to provide a structured way to access and interpret patient data and, at the same time, provide a variety of information resources to increase the level of knowledge of the nurse decision maker (Henry 1995). Information and data content should be considered along

with ensuring that it is presented in a concise and reliable way that facilitates the decision-making process, making it as straightforward as possible (Thompson 2001). With specific reference to IT, the Nursing & Midwifery Council (2004) produced guidelines saying (p. 12) that 'the same basic principles that apply to manual records must be applied to computer-held records', specifically: security, patient involvement and accountability.

Aim

The aim of this paper is to explore existing nursing research on inpatient hospitals' IT systems to discuss new approaches for evaluation research on nursing informatics to guide further design and implementation of effective IT systems.

Method

A literature review was carried out using the electronic databases CINAHL and Medline using the search terms 'nursing information systems', 'clinical information systems', 'hospital information systems', 'documentation', 'nursing records', 'charting' from 1995 to 2005 which sought journal articles, research papers and systematic review, but excluded anecdotes, responses, brief items and commentaries. It was combined with electronic* and computer* (the boolean* ensured that all words beginning with these terms were included in the search) and excluded management and legal publications and those with no more than 10 references. A total of 588 articles was retrieved and their subsequent relevance to the study assessed by manual reviewing of abstracts.

Articles related to full electronic patient record systems or electronic nursing record systems were kept for review, whereas those related to specific applications, such as medication prescription, decision-support systems, laboratory or X-ray images were rejected. In addition, articles which focused only on classification systems and taxonomies were rejected. Finally, as the review refers only to the inpatient setting, articles carried out in outpatient areas were excluded. A total of 74 articles was selected for full article review, some of these could not be obtained or were rejected for the above reasons, leaving 39 items to be used for the review.

In addition, a manual review of the past five years of articles in the *Journal of American Medical Informatics Association*, *International Journal of Medical Information* and *Computers in Nursing* and a manual search of papers in the reference lists of the systematic reviews was carried out.

Results

Potential benefits of IT such as accessibility, readability, completeness, decision-support and access to knowledge bases are widely recognized and have provoked the adoption of information system tools in healthcare organizations (Powsner *et al.* 1998, Nikula *et al.* 2000, van Ginneken 2002). Nevertheless, authors recognized the use of information systems for clinical practice is still in its early stages and as Giuse and Kuhn (2003) p. 107) say 'truly successful stories are not common', with many healthcare institutions still using manual information processes.

Requirements of IT systems

It is important to take into account that technology is a tool, an enabler to enhance clinical practice and not the driver of clinical practice (Jenkings 2004); therefore, it 'should be judged by its ability to present reliable, relevant data to clinicians in a usable form, when and where needed' (Powsner *et al.* 1998 p. 1619). In this context, different requirements of health information systems have been highlighted:

1 The need for an integrated patient record that allows health professionals' entry and access to data from different places at the same time. Such a record enhances communication and quality of patient care (Ball *et al.* 2003).
2 The need for user involvement in all phases of the implementation including design and evaluation (Helleso & Ruland 2001, Rodrigues 2001, van Ginneken 2002, Currie 2005).
3 The importance of organizational issues such as culture, innovation and leadership for effective implementation process (van Ginneken 2002).

Nursing is increasingly involved in studies and research on informatics and the emergence of nursing informatics as a discipline within nursing is evidence of this. 'The practice of nursing has evolved to take advantage of the technology and, in many cases, drive the technology' (Hersher 2000 p. 80). Despite this, the lack of a solid knowledge and research base within the nursing informatics literature is evident and there is a need for further research, publication and dissemination of objective information on implemented health information systems (Sleutel & Guinn 1999, Ball 2003, Friedman & Abbas 2003).

The complexity of the object of evaluation, the complexity of the evaluation project and the motivation to perform evaluation make IT evaluation research difficult, but not unachievable (Ammenwerth *et al.* 2003a). The tremendous benefits from IT implementation in clinical practice can be

transformed into tremendous hazards when ineffective applications are introduced. 'Having too much, poorly organized information can cause as many errors in decisions as having too little information' (Tierney 2001, p. 1). Research is needed to determine the success and effectiveness of IT systems in clinical practice to support and enhance the rapid and wide introduction of IT systems in healthcare organizations.

Indicators of successful IT systems

van der Meijden *et al.* (2003) carried out a literature review of determinants of success of inpatient clinical information systems over a 10-year period (1991–2001) and found that there is no explicit definition of success and it fluctuates over time. Success is considered to be a multi-dimensional concept which encompasses system, individual and organizational factors. System and information quality are the factors most widely analysed in IT evaluation research and which both individually and jointly affect usage and user satisfaction (van der Meijden *et al.* 2003).

Studies within nursing focus on electronic record completeness, nurses' satisfaction with information tools and the correlation of nurses' characteristics (such as expertize, level of use of computers and age) with satisfaction. Questionnaires are the method most widely used, together with qualitative approaches including observation, interviews and focus groups. Some longitudinal studies have been carried out looking for changes over time after the introduction of IT systems, both in quality of documentation and user satisfaction (Nahm & Poston 2000, Ammenwerth *et al.* 2001a).

Some of the clear benefits of IT implementation are issues of quality of data: being more complete, accurate, up-to-date and reducing redundancy. Nevertheless, the meaning of quality of data needs to be further analysed. Hogan and Wagner (1997), in a review of studies on data accuracy, refer to the lack of sound research in this area, although some ideas can be highlighted. Data accuracy is based on completeness and although data can be considered complete from a theoretical perspective, it is not always checked whether the data accurately and completely reflect the patient situation. They highlight how perspectives, completeness and correctness are conditions for data accuracy. Studies of nursing records, both manual and electronic, refer to completeness and, explicitly, they do not address the accuracy aspect (Karkkainen & Eriksson 2003). On the contrary, the focus of much research is on data entry, but not on causes of inaccurate data, a relevant aspect if computerized patient records (CPR) are supposed to enhance clinical decision-making and reduce errors in healthcare organizations.

Another aspect, when looking at quality of data, is usefulness; not just completeness, but meaningful and relevant information for patient care (Urquhart & Currell 2005). Over-documentation tendencies containing non-purposeful and superfluous data is a risk associated with the introduction of IT systems (Stokke & Kalfoss 1999). Ammenwerth *et al.* (2001a)) in a randomized study comparing computer and paper documentations, found in the computer documentation review unspecific and long, less-individualized documentation and too many not executed tasks. Nurses in the study recognized that computer documentation is more complete, legible and of better quality.

Records are written once, but read many times, so it is important not only to have the right data but also to have it in the right format and language that make it comprehensible and usable for clinicians, as Jenkings (2004), pp. 312) says: 'it has to be made available in a ready to hand format'. Nygren *et al.* (1998) and Wyatt and Wright (1998) suggest how information design is about managing the relationship between people and information so that the information is accessible to and usable by people and highlights the need to understand how and why clinicians search records and the factors that make it easier. This is an important area of research developed more in medicine than in nursing looking at the interaction between doctors and the medical record. Data from this area have been used to understand the relationship between people and information and therefore to define the characteristics of electronic records to make data accessible and usable by professionals.

Individualized care and structured data

It is widely recognized that structured data entry and the use of formalized nursing language in a Nursing Information System (NIS) can contribute to a better data capture by nurses (Nahm & Poston 2000, Daly *et al.* 2002, Urquhart & Currell 2005). In addition, structured formats and predefined care plans make planning activities easier and more effective and records are more complete (Ammenwerth 2001a). 'However, formal, explicit, general and objective discourse cannot explain the discourse of the particular that is essential to nursing knowledge' (Rodrigues 2001 p. 100). Taking into account that data are accessed by different people at different times, explicit and formal information may facilitate the same understanding of information for continuity and co-ordination of care, although some richness could be lost. Research into the concept of knowing the patient has defended the failure of formal assessments or information provided in the shift report to reflect the patient situation (Tanner *et al.* 1993, Radwin 1995). Nevertheless, they did not state whether the

information was considered to be useless or how it contributed to the process of knowing the patient. In other words, the extent to which knowing the patient is based on explicit and formal information about the patient has not been studied. Nurses in these studies refer to this kind of knowledge of the patient as being more than what they know about the patient as a result of a formal assessment or explicit data-based knowledge. It implies a personal relationship that allows nurses to recognize changes in the patient response and individualization of interventions, particularizing prescriptions or general rules to this patient in this situation (Tanner *et al.* 1993, Radwin 1995).

Zeitz and McCutcheon (2002) carried out a study on policies on postoperative observations in 75 surgical hospitals. Despite the low response rate (40%), it is interesting to note that a documented, predetermined process, rather than a practice driven one was observed in clinical practice. Structured practice and structured documentation have the potential risk of a rigid system of practice where individualized care can be put at risk (Lee 2005). A balance is needed and IT systems, whereas enhancing completeness through structured formats, should promote and facilitate individualized care.

User satisfaction

User satisfaction and experiences are other areas of interest within nursing literature on IT evaluation research (Ammenwerth & Keizer 2005). Nurses' attitudes have been defined as a key element for implementation success (Marasovic *et al.* 1997, Dillon *et al.* 2005). Although, conflicting results make conclusions difficult, agreement can be found regarding satisfaction with the timely and efficient retrieval of results with IT systems. Darbyshire (2004) in a study on nurses' experiences using information systems in their daily work describes it as negative and critical. Lee (2005), despite an overall positive experience, when analysing written comments in questionnaires, corroborates negative aspects in the use of a computerized care plan system from previous quantitative analysis. Time-consuming, no clinically relevant and system problems are some of the IT problems described by users. Attitudes studies have also analysed the correlation between nurses' attitudes and satisfaction with demographic data such as age, prior experience with computers, experience in nursing, educational background, with conflicting results; for example, Sleutel and Guinn (1999) found no significant differences in nurses' attitudes when compared with individual characteristics and Dillon *et al.* (2005) found significant results for age.

Current issues in evaluation of IT systems

Despite the amount of research carried out to evaluate IT systems within healthcare organization, it can be considered as being in an early stage. The following issues are raised:

1 There is a lack of quality research and measurement tools. Attempts to conduct systematic reviews make obvious the lack of solid and conclusive research (Moloney & Maggs 1999, Ammenwerth *et al.* 2003b). Friedman and Abbas (2003) in a literature review of measurement tools from an initial retrieval of 414 citations only 27 met the inclusion criteria of report of validity and reliability and reuse of the tool in different studies, and not all criteria were found in any study.
2 Studies are more descriptive, focus on technical and not contingent factors (van der Meijden *et al.* 2003). As a result, no conclusions about the relationship between the system, the context, both the users and the organization, and the results can be inferred. 'Advocates of health care computerization may suggest that the problems identified by these end-users may evaporate when technology improves. This is a fond hope that assumes that such problems are essentially technical rather than social and cultural in nature, but it seems that even the most sophisticated technology will fail in the absence of clear appreciation of the needs, perceptions and experiences of end-users' (Darbyshire 2004, pp. 23).

Within this context there is a change in the perspective of IT designers to a wider understanding of information systems changing the object and approach of evaluation studies. Consideration is being given not just to task-specific solutions but also to how technology has an impact on the organization and the interaction between people and IT to enhance the users' experience. 'Together, people, tools and conversations – that is the system' (Coiera 2003 p. 206). IT systems cannot be evaluated in isolation from other resources and information processes within healthcare organizations.

Discussion

Current research can be considered as giving some insight, but an incomplete picture of IT system implementation in clinical practice. Nevertheless, evolution both in IT theoretical approaches and evaluation research has opened a new road for a more comprehensive analysis of IT implementation.

Berg (2001) introduces what is called the socio-technical approach in the analysis of information systems and the design of the implementation process. He criticizes the traditional approach for IT implementation which focuses

on the individual doctor or nurse decision-making process as a sequence of logical steps and defends the process as a two way process, that 'involves mutual transformation of the organization by technology and of the system by the organization' (p. 147). He emphasizes the importance of the professional culture and working patterns and the need for qualitative studies to explore working practices for effective understanding and implementation of information systems. Talking about the failure of many IT implementation projects in clinical practice, Giuse and Kuhn (2003) recognize that the reason could be a direct consequence of technology-oriented rather than social and communication-oriented nature of most healthcare information system (HIS) applications. Patel *et al.* (2000) conducted a study to determine the influences of the use of CPR on doctors' reasoning and documentation practices. They concluded that the use of CPR changes the organization of information on patient records and produces differences in the use of CPR with the development of personal interaction after some time using it. There is a rising tendency to include social and organizational aspects within evaluation studies of IT in healthcare (Ammenwerth & Keizer 2005).

In parallel, evaluation research is moving from being a mere instrument to measure whether a programme works towards an exploration on how it works, looking at the underlying principles for effective implementation (Clarke 1999, McEvoy & Richards 2003). Evaluation research, from this perspective, is used to establish the relationship between theories, processes and outcomes exploring causal mechanisms (Clarke 1999). It can be considered as a theory testing approach where early theory comes from documents, people, prior research and reasoning and it is checked during the evaluation by different methods. Evaluation research incorporates a new perspective from the traditional method-driven approach within either the quantitative or qualitative approach. In the theory-driven approach, it is the question that drives the methodology and not in the other way round (Pawson & Tilley 1997). This approach seems to cover some of the deficiencies already found in IT evaluation research that highlights the need to study causal relationships and the advantages of a multi-method approach for a more comprehensive picture of the phenomena.

In this context of theory-driven perspectives of evaluation research emerges realistic evaluation. It has its origins in the philosophical perspective of critical realism, which has as key features: generative mechanisms, the stratified character of the real world and dialectic interplay between social structures and human agency (Pawson & Tilley 1997, McEvoy & Richards 2003, Byng *et al.* 2005). The main aspect is that of generative mechanisms based on causality being not external, but an internal potential of the programme or intervention that is activated in the right conditions. 'Generative mechanisms may remain latent until they are activated in the right circumstances' (McEvoy & Richards 2003 p. 412). The question is about why or how this works in these circumstances (Forbes & Griffiths 2002). Context, mechanisms and outcomes are essential parts of evaluation research and realistic evaluation look at the relationship underlying them, what works for whom in what circumstances (Pawson & Tilley 1997). Theory is constructed as different configurations of context-mechanism-outcomes that explain the phenomena under study.

Context-mechanisms-outcomes configurations are generated and expressed as hypotheses. Different methods and data collection methods are used based on the research questions. It is not an experimental approach, it does not manipulate the context as it is another variable to take into account; and it is not a constructivist approach as data construction is guided by the researcher's theory (Pawson & Tilley 1997).

Information technology system implementation can be considered as a multi-dimensional open system from the socio-technical approach point of view with potential benefits that will be achieved in specific circumstances. Realistic evaluation may be an appropriate method for a more comprehensive approach to IT implementation. 'The task is to produce some middle-range theory in the form of context, mechanism and outcome configurations, which is abstract enough to underpin the development of a range of clinical systems, but concrete enough to withstand testing in the details of system implementation' (Heathfield 2005 pp. 12).

Overall success is difficult to define; it has many dimensions and in addition, different parties can have different opinions about their relevance (Berg 2001, van der Meijden *et al.* 2003, Ammenwerth *et al.* 2003a). 'The question about the success of a system, then, becomes the question of success *for whom*' (Berg 2001 p. 145). Contextual factors also play an important role and should be taken into account and make each a unique one (Berg 2001, Meijden *et al.* 2003). 'Freezing the environment during the study period is neither useful nor possible' (Ammenwerth *et al.* 2003a p. 127) and therefore experimental designs appear difficult to carry out and incomplete for a comprehensive picture. Multi-method and flexible approaches to evaluation research are needed (Meijden *et al.* 2003, Ammenwerth *et al.* 2003a). 'In evaluation of information systems that employ multiple methods, the data from different sources complement each other to provide a more complete picture' (Meijden *et al.* 2003 p. 242).

Conclusion

It would appear that as a result of the complexity of the issues, complete evaluation of the implementation of IT systems is not feasible. Successful implementation is a multidimensional concept understood differently by various stakeholders and contextual factors play an important role. Integration of nursing information systems into nursing practice involves more factors than just technology such as education, changing attitudes, cultures, standardized documentation and healthcare practices. 'It is advisable to view a NIS not only as software and hardware, but also as people, organizational structures and processes that allow the collections, processing and use of information in nursing' (Goossen *et al.* 1996 p. 60). The rapid introduction of IT systems for clinical practice urges evaluation of already implemented systems examining not just whether they work, but how and in what circumstances they work. Such research could guide effective further development and implementation of IT systems to:

1 provide a comprehensive evaluation of the implementation of a computerized nursing record as a part of an integrated electronic patient record system and variations between different wards, units and nurses.
2 evaluate the impact of IT systems on nurses' practices of data collection and information use and collaboration within the health team.
3 describe the system characteristics that positively and negatively influence clinical practice and the reasons for it.

Realistic evaluation offers a way forward; it could provide configurations of context-mechanism-outcomes that explain the underlying relationships to understand why and how a programme or intervention works, in this case, the use of IT systems for nursing documentation in clinical practice.

Furthermore, realistic evaluation has potential for theory development both in nursing and IT development. Accumulation and convergence of results from different studies using a realistic approach could uncover general principles moving theory development from specification to higher levels of abstraction. 'The accumulation of results and the gradual convergence on information of higher quality is the hallmark of progress in any science, but is particularly key in social science, where there may be no single, uniform answer to a given situation, but rather a family of answers, related by principles that emerge only over the course of much research' (Cook *et al.* 1992 cited in Pawson & Tilley 1997 p. 115).

Although realistic evaluation is not yet widely used in nursing research, it is already relatively often cited within nursing literature on evaluation research and a optimistic attitude when looking at its features suggest a promising future in this direction. For example, a search made on CINAHL produced 42 articles referring to Pawson and Tilley (1997) in the past five years.

'Critical realism promises much as an approach that encourages us to look beyond surface appearances to search for the underlying processes that account for natural and social phenomena. The challenge for nurses who adopt a critical realist standpoint within evaluation research is to demonstrate its practical efficacy and show that it offers more than speculative theory and critique' (McEvoy & Richards 2003 p. 418).

Contributions

Study design: CO, RW; data collection and analysis: CO; manuscript preparation: CO, BE, RW.

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