

1. INTRODUCTION

1.1 Purpose of study

The purpose of this research is to discover why end users accepted or rejected the point-of-care (POC) clinical information system (CIS) at the Flora Clinic Hospital, Roodepoort, Gauteng, South Africa.

In order to make this discovery, the study will analyse the post-implementation environment at the hospital.

1.2. Context of study

Information is the lifeblood in a healthcare system for both the people delivering the care as well as to the patients receiving it (O'Kane, 2002).

Healthcare institutions are information-intensive and in recent years the demands for information have intensified due to among other factors, a focus on cost-effectiveness, quality assurance and clinical outcomes (Anderson,1997).

Computer based information systems have been developed and used in the healthcare environment for nearly thirty years and were initially designed primarily for administrative purposes to ensure that all charges were billed and collected (Anderson,1997). In the 1990s there was a shift from administrative systems to clinical information systems due to the fact that the current goals of cost containment and outcomes measurement could not be met by the older administrative systems (Anderson, 1997).

Over time the hospital information system with its historical administrative functionality has become much more focused on the clinical perspective and patient record, while also becoming more open in a technological as well as an organizational sense (Kuhn & Giuse, 2001).

Although this move in the healthcare industry towards the digitized flow of information was slow and difficult (Flower, 2003), healthcare has already profited greatly by the continuous development in IT (Haux, Ammenwerth, Herzog & Knaup, 2002).

The demand for computerization in healthcare also appears to be on the increase (Lang, 2003) and hospital information systems are regarded as one of the cornerstones of modern hospital care (Doyle, 2002).

The implementation of an information system is a complex process and there is no broad consensus on a successful implementation, or a single implementation strategy (Jiang, Muhanna & Klein, 2000).

A key factor to which many information system implementation problems have been attributed is end users' resistance to change and researchers have recognized end users' acceptance of a system as a major objective of system implementation (Jiang et al, 2000).

In the process of implementing information systems, many healthcare organisations have experienced resistance from the nursing staff (Kirkley, 2004).

In a study on nurses' opposition to IT, Timmons (2003) found that resistance from nurses comes in a variety of forms and is a complex, multidimensional phenomenon worthy of additional study.

1.3. Problem statement

1.3.1 Main problem

The purpose of this research is to discover why end users accepted or rejected a clinical information system (CIS)

1.3.2 Sub-problems

The sub-problems derived from the main problem are:

Sub-problem 1

What factors affected the acceptance of the CIS by end users?

Sub-problem 2

Why do individual end users differ in their acceptance of the CIS?

1.4. Significance of study

This study will attempt to provide hospital management and CIS implementation consultants with more insight into

- which factors should be focused on during CIS implementation
- how end users decisions can be better understood and more effectively influenced.

These factors can contribute to the more favourable outcome of CIS implementation.

1.5. Delimitations and limitations

1.5.1 Delimitations

Due to the fact that the research will use the case study methodology, the scope of the study will be limited to the CIS implementation at the Flora Clinic.

1.5.2 Limitations

The limitations to this study are linked to the fact that qualitative research will use the case study methodology in the interpretative paradigm.

- Due to the fact that the researcher is an instrument in qualitative research (Leedy & Ormond, 2001), there is a distinct possibility that the findings of the research might be influenced by the researcher's biases. An active attempt will be made to be aware of these biases in order for them not to influence the findings of the research.
- One of the major problems with single case, case studies, is that they offer a poor basis for generalization (Yin, 1994). With this in mind the purpose of this case study is not necessarily generalising to a population, but rather one of articulating patterns and adding to theory building (Human, 2003 ; Amaratunga & Baldry, 2001).

1.6. Definitions of terms

The following terms will be used extensively in the proposal and it was deemed appropriate to provide their definition:

- Information systems (IS) are a set of interrelated elements or components that collect (input), manipulate and store (process), and disseminate (output) data and information, and provide a feedback mechanism (Stair, 1996).
- Clinical information systems (CIS) are systems of microcomputers used at patient bedsides to collect, process, retrieve, and display information related to patient care (Williams & Brown, 1994).
- The term systems implementation refers to the number of tasks that must be completed before the system is installed and ready to operate (Stair, 1996).

- An end user is defined as 'a person who actually uses a product rather than one who makes or sells it, especially a person who uses a product connected with computers.' (Oxford Advanced Learners Dictionary).
- The Point-of-Care (POC) system is described by a Flora Clinic Hospital information leaflet as an information system which consists of a handheld computer, a server and software. The POC system enables nursing staff to capture information at the patient's bedside.

1.7. Assumptions

In order to attempt this study the following assumptions will be made:

- It is possible to discover why end users accepted or rejected CIS
- End users differ in the way they interpret and pay attention to different factors.

1.8. Subsequent sections of the Research Report

An in depth review of literature relevant to information technology in the healthcare setting will follow this introductory section. Thereafter a discussion on the case study methodology will precede a description of the Flora Clinic case study in which it will be used. The findings of the data analysis and a discussion thereof will follow in separate sections, whereafter recommendations to the industry will conclude the report.

2. LITERATURE REVIEW

This section aims to

- discuss the benefits that information technology offer to the healthcare industry,
- address the core challenges that face implementers of technology to healthcare and
- extract industry specific factors influencing technology acceptance.

2.1. The benefits of information technology (IT) to the healthcare industry

The following are benefits that stem from the use of IT in healthcare as discussed in the literature:

2.1.1 *Management of clinical information*

In order to ensure that information is used in an effective and efficient way, it has to be well managed (Gladwin, Dixon & Wilson, 2002).

The definition of knowledge* management in the context of healthcare is as follows:

“Within medicine, knowledge management can be defined as the creation, acquisition, analysis, maintenance and dissemination of knowledge for the benefit of patient care.”
(Sensky, 2002)

The importance of knowledge management to healthcare lies in its ability to provide end users, like doctors, with the tools to practice evidence-based medicine and to meet the needs of good clinical governance (Sensky, 2002).

The use of CIS by doctors significantly improves the reporting, organizing, and locating of clinical information. It offers end users a vast improvement over traditional paper charts, which provide only about a third of the data that the doctors need while providing patient care (Anderson, 1997).

For nurses also, current paper documentation is a tedious, redundant process that is prone to human error and there are enormous benefits from a computerized nursing system (Williams & Brown, 1994).

*Note: With only the application of a deeper level of understanding separating information and knowledge (Sensky, 2002), these terms will be used interchangeably.

Computerised information systems enable nurses and nurse administrators to collect, manipulate, store, retrieve, display, and communicate data. This processing of data allows for better administering of nursing services and resources, manage nursing practice management for improved patient care outcomes and advance nursing knowledge (McConnell, 1999).

An example of distinct information management advantages due to the use of an information system, is the improvements that followed the use of computer based ordering systems in the healthcare setting. These improvements came about due to a reduction in ambiguity and transcription errors as well as the availability of more timely and complete clinical information (Anderson, 1997).

Not only will information be more accurate, timely and complete but the faster flow of information due to technology will also make medical practice more dynamic. This faster flow of information will, for example, have the benefit that the feedback loop between medical research and clinical practice will become faster (Flower, 2003).

The use of information systems by frontline workers also provides healthcare organisations with the potential to learn from their failures and problems. This process will help hospitals to move towards becoming true learning organisations (Tucker & Edmondson, 2003).

Information technology therefore offers a distinct advantage to healthcare through its ability to improve the management of clinical information, but there are non-technological barriers that might complicate the information management process.

The most important barrier is likely to be the culture in an organization and not inadequate resources as is commonly thought. Cultural values like trust, openness and a tolerance of mistakes will improve knowledge management and should be reflected throughout an organization (Sensky, 2002).

2.1.2 Clinical decision support

Another important benefit described by many authors in the literature is the ability of IT to support clinical decision-making.

Clinical decision support systems offer clinical knowledge and information to care providers to support them in their decision making with the goal to enhance patient care (Bowles, 2004). These clinical decision support systems can for example help detect dangerous or

potentially dangerous laboratory values, drug-to-drug interactions, patient allergies, risk profiles, or treatment contra-indications and errors of omission (Bowles, 2004).

An example of such a decision support system is the CPOE (computerized physician order entry) system, that incorporates clinical decision support tools, including evidence-based rules, alerts and treatment guidelines (May, 2003).

May describes how the value of decision-making support to doctors at the point of care provides a sound rationale for the use of these systems by the doctors and, in many cases, drives demand for CPOE by them.

It should be noted that decision support systems should however not be conceived as independent tools, with the ability to substitute the human expert on demand, but should rather be integrated with the knowledge management task in the hospital (Montanni & Bellazi, 2002). As a decision support tool, information technology also does not have a generic approach to patients with the same combinations of disease, but supports the physician in his/her decision making (Weiner et al, 2003).

The use of information technology in the healthcare environment can also help bring relevant information to the decision making point to augment quality improvement activities and practice guidelines (Tierney, 2001). In the context of continuous quality improvement, for information to be most useful, it must be relevant to both the processes and outcomes of care, or in other words, should be available at the time and place it is needed and be specific to the task at hand. (Tierney, 2001) If the amount and type of clinical information is not made available to doctors in the right form and at the right time (Montanni & Bellazi, 2002; Tierney, 2001), instead of enhancing doctors' clinical decision-making, information has the ability to confuse the process (Tierney, 2001).

As mentioned above, decision support systems not only provide information to support quality improvements, but also provide information on guidelines, warnings or alerts about drug interactions, costs of clinical diagnostic procedures and other clinical events requiring attention, or reminders to follow up on routine procedures (Anderson, 1997).

Nurse leaders can also utilize data available on hospitals' clinical information systems to support strategic decision making in areas like

1. outcomes analysis and the efficacy of nursing care,
2. optimization of facilities and resource utilisation, and

3. development of broader disease management initiatives for patient populations (Kirkley, 2004).

Through the use of clinical IT these nurse executives can make fact-based decisions on important organisation-wide strategic initiatives to improve the successful outcomes thereof (Kirkley, 2002).

IT's ability to provide decision support to healthcare providers is just a first line benefit and authors like May (2003) and Anderson (1997) describe how other benefits like the improvement in patient safety and outcomes, and decreases in healthcare costs, follow directly from this.

2.1.3 Improved ability to practice evidence-based medicine

As already mentioned, healthcare information and knowledge sharing by healthcare professionals are important in order to practice evidence-based medicine, and to meet the demands of clinical governance.

The role of connectivity in the sharing of healthcare information and knowledge are discussed by Pendharkar & Roger (2000:38) who state that:

“Connectivity leads to shared care that comprises the continued, coordinated, and integrated activities of different people from different institutions applying different methods in different time frames, all in a combined effort to aid patients medically, psychologically, and socially in the most beneficial ways.”

Through connectivity, computers and communication systems thus improve the sharing of healthcare information by overcoming the limitations imposed by the dimensions of time and location (Orthner, 1994). These digital additions to healthcare enable medicine to become more evidence based in that doctors will find it easier to adapt to best practices (Flower, 2003).

2.1.4 More effective and better quality patient care management

Care complexity

“(The) coordination of the complex tasks involved in providing patient care is one of the most important organizational processes in the delivery of health services.” (Anderson, 1997:85)

The use of information technology in healthcare, offers the ability to coordinated work activities better (Stefanelli,2002; Berg,1999).

In healthcare, the care provided to patient groups differs and for certain groups of patients care provision is more complex than for others. In these more complex cases information technology acts as a tool that can help doctors meet the challenges of care complexity required by these groups (Weiner & Calahan, 2003).

An area in which IT can benefit patient care is within specific patient communities. Community-based information systems can help solve this problem of fragmented care across specific hospital, clinics or extended care setting borders (Wiener and Callahan, 2003). Through access to patients' records and by improving communication among providers, information systems can provide continuation of care and improve patient safety (Wiener & Calahan, 2003).

Another specific care area that can benefit from IT, is the area of home care to patients. Technology decrease the distance between patient and healthcare provider and patients can benefit from devices that can be used at home (Flower, 2003). By improving care complexity through the utilization of information technology, the quality of care provided will also automatically improve (Flower, 2003).

Quality of care

Information technology has also consistently been identified as an important component of any approach towards quality improvements per se and the continuation thereof in a healthcare system (Kuperman & Gibson, 2003).

An example of how information systems have the ability to improve quality of care, is the ability of computer-based record systems to enable integrated care delivery through multi-professional electronic patient records, whilst also providing quality assurance processes (Rigby, 1999).

2.1.5 Cost containment

Surveys have found that the need to control costs is the major force driving investments in healthcare information systems (Anderson, 1997).

The cost benefit that IT provides to the healthcare industry follows mainly from the improved information and knowledge management and its ability to provide clinical decision support as described above.

An additional way in which IT can be cost beneficial is through the better workforce management. In any healthcare organization, labour costs account for the greatest costs of operation (Forte, 2004). Technology provides mechanisms for management to increase staffing accuracy, monitor labor use and to effectively manage the workforce and maximize their efficiency (Forte, 2004).

IT can also be used to influence doctors' clinical decisions. This might be a very powerful way of reaching the cost objective in that these decisions generate more than three quarters of all healthcare costs (Anderson, 1997).

An example of how IT decreased cost is evident in a case where medical records were moved online in a hospital setting. The reduction in physical space occupied and staff numbers saved the hospital thousands of dollars each month (Steeley, 2003).

Cost benefits to healthcare due to the use of information technology have also been describe by Weiner and Callahan (2003), May (2003), Flower (2003) and others.

2.1.6 Save time

Information technology also has the ability to save healthcare providers time in their daily activities.

In one example the implementation of an information system in an intensive care unit (ICU) at a certain medical centre decreased the time spent on documentation by ICU nurses by over 30%, and increased their time spent doing direct patient care (Nursing Economics, 2004).

For non-clinical functions such as utilization review, risk management and quality assurance, the ability to easily extract specific data from a chart is a tremendous timesaver (Steeley, 2003).

2.1.7 Other benefits

The benefits described above are not the only ones and additional benefits are mentioned below.

Hospitals might improve their images

Steeley gives an example of how through the ability to minimize the travelling that doctors have to do by giving them remote access to patients' charts, the hospital where they

worked acquired a reputation for being more technologically advanced than the bigger hospitals in the same vicinity.

Through this perception the smaller hospital gained a competitive advantage in attracting some of the best cardiologists and other specialists to practice their facilities, which in turn helped them to achieve their goal of being a model healthcare provider in rural Florida (Steeley, 2003).

There is also an observed decrease in errors and drop in malpractice in hospitals with electronic medical records and digitised systems (Flower, 2003).

Reasons for this was:

1. It is more difficult to make errors when you are double checked by software.
2. How accountability, decisions and orders become easier to trace.
3. The use of so called black boxes in operating rooms to record operations.

The first level benefits that IT offer to the healthcare industry (improvement in speed, control, accountability, cost containment and customer satisfaction) are seen as superficial benefits by authors like Flower (2003). In Flower's (2003) opinion, IT provide more deep lying benefits that have the potential to change the face of healthcare as it goes into the 21st century (Flower, 2003).

2.2. Core challenges around Information Technology in the healthcare industry

The following issues are addressed in the literature around the use of IT in healthcare organizations.

2.2.1 Information system integration and standardisation

Information system integration is seen as a central issue in health information systems with the lack of systems integration being one of the core problems in healthcare information system implementation (Kuhn & Guise, 2001).

One of the functions required by healthcare organisations is the need for timely patient information from various sources at the point-of-care. For these organisations the ideal

situation would be where they can acquire an integrated system from one vendor that will optimise this function (Kuhn & Guise,2001).

The problem in healthcare is that special-purpose applications offer good solutions to certain niche problems found in hospitals, but that the niche applications might make enterprise-level integration difficult (Kuhn & Guise,2001). Due to the fact that these specialized systems are being used broadly, Kuhn and Guise describe how the reality of clinical practice is one where there are still largely non-integrated applications, with the resulting lack of heterogeneity remaining a key problem (Kuhn & Guise,2001).

In order to address this integration issue Kuhn & Guise (2001) propose standardisation as a solution and mention how there is overwhelming consensus that standards are essential for solving this problem. Not only will this solve the integration issue but through the practice of bulk IT purchase and standardisation of data and procedures, the organisation might also benefit from cost savings (Southon, Sauer & Grant, 1997).

An example of how information systems integration during implementation paid off, was in the Indiana Heart Centre. During the planning stages the decision was made that systems integration was key and the implementation ended up as being very successful because of the integration focus (Knoedler, 2003).

2.2.2 Information system integration into clinical processes

Although IT is seen as an enabler in healthcare processes improvement, through information provision at the point of care, (Lenz & Kuhn, 2004) the adaptation of information systems to these processes remains a major problem in healthcare (Kuhn & Guise, 2001). This problem consists of both socio-technical and technological dimensions and in order to address this problem, new concepts for health information systems, suitable to the healthcare process, are needed (Kuhn & Guise, 2001).

The importance of information systems adaptation to institutional processes is endorsed by authors like Haux et al (2002) who have identified process-integrated decision support through current medical knowledge as one of three major goals requiring achievement for future healthcare provision.

The down side of information systems not integrated into work processes is that it might cause

- The non-productive acquisition of information

- The organization might miss the possibility of healthcare process improvement
- An increase in workload
- System rejection

The issue around IS integration into healthcare processes will be discussed in more detail in a later section.

2.2.3 The importance of human-computer interaction

In healthcare, computer-based information systems have generally met with limited acceptance among end users like doctors (Anderson, 1997). An important problem confronting implementers of new IT systems is how to persuade the end users to adopt these new systems (Agarwal & Prasad, 1999).

The importance of IT system acceptance by healthcare end users leads from the fact that healthcare providers will need to interact directly with clinical information systems in providing patient care. Only through this direct interaction will they be able to take full advantage of the ability of these systems to organize their information and to support them in clinical practice (Anderson, 1997).

2.2.4 Socio-technological and organisational issues

According to Lorenzi & Riley (2000), *“Socio-technological issues refer to the issues surrounding the interaction of the technology with the people using the technology to perform a task.”*

The importance of socio-technological issues is voiced by authors like Kuhn and Guise (2001), who are of the opinion that in order for healthcare information systems to work, people and not technology, should be the critical issue. In the context of the healthcare information systems environment they see technology as the enabler and not the driver and in support, cite Anderson (1997) who found that the critical issues in the implementation of IS are social and organisational, and not just technical.

Current day informatics implementations are also becoming increasingly dependent upon how well the people and organizational issues are managed. This is especially applicable to the larger scale implementations (Lorenzi & Riley, 2000). Authors like Reed Gardner (Gardner & Lundsgaarde, 1994) provides estimates that as much as 80% of the success of

an implementation project is dependent on the development of the social and political interaction skills of the developer and 20% or less on the actual hardware and software technology implementation (Lorenzi & Riley, 2000).

It thus appear that not only are socio-technological issues currently very important in information system implementation, but also that the importance will grow as these implementations become larger in scale.

The issue around end user acceptance, socio-technological and organizational issues will be discussed more extensively in later sections.

2.2.5 Design

Berg (1999) describes how the inadequate design of an information system (e.g. an inadequate end user-interface) will reduce its chances of being successfully implemented.

He (Berg, 1999) is also of the opinion that if end users are not sufficiently involved in the design process, they might experience the user-IS interface as illogical from their point of view. He provides an example of this when he describes how the sequence of actions prescribed by the system may run against the end users' working routines (Berg, 1999).

In a critical analysis of the information system in the hospital where he worked, Doyle (2002) identified end user interface adaptability as one of the main problems surrounding the information system.

2.2.6 Return on investment

The difficulty in demonstrating return on IT investment also remains a problem with the subsequent financial benefits of IT in healthcare still extremely difficult to quantify. (Kuhn & Guise 2001) In a hospital survey, Haruki, Ogushi, Okada, Kimura, Kumamoto & Sekita (1999) found that the effect on cost improvement and benefits had not met with expectations (Kuhn & Guise, 2001).

2.2.7 The issue around successful clinical information system implementation

An in-depth discussion of clinical information system implementation will be provided in one of the following sections.

2.3. Technology acceptance in healthcare

The introduction of technology into organizations has been studied in many contexts and from a variety of theoretical perspectives. In determining the success of the implementation not only have the characteristics of the organization (complexity, size, communication, participation) and the technology (easy of use) been explored, but also factors around the individual (age, education, attitudes) (Hebert & Benbasat, 1994).

Humans play an unique and important role within socio-technical interaction (Thompson, 2002) and the rapid growth of investment in IT by organizations worldwide has made end users acceptance an increasingly critical technology implementation and management issue (Chau & Hu, 2001).

The issues surrounding end user acceptance and related issues is however not a new one and user attitude, perceptions, acceptance and use of IT have been longstanding issues and major themes of management information systems (Zhang, 2003).

The importance of end user acceptance of an information system has been recognized by many IS researchers as a major objective of system implementation (Jiang et al, 2000). Acceptance models like the TAM (Technology Acceptance Model), as described below, equate system success to actual utilisation of the system through system acceptance and describe that without system use the other benefits offered can not be realised (Agarwal & Prasad, 1998).

It also appears that the actual use of an information system makes the implementation successful. This statement is made based on how authors like Ash et al (2003) define a successful information system implementation in a healthcare context as an implementation that leads to heavy use (over 80% of orders entered electronically) by a large number of end users.

Acceptance of the system will therefore lead to system use, which will realize system benefits and make the system implementation successful.

Hu, Chau, Sheng, & Tam (1999) describe how three important dimensions stem from the factors that can be used to explain, predict and manage user acceptance. These dimensions are the

1. characteristics of the individual,
2. characteristics of the technology
3. characteristics of the organizational context (Hu et al, 1999).

These dimensions mentioned by Hu et al (1999), provide a springboard from which end user acceptance in a specified setting can be evaluated.

Through the literature review additional factors came to the fore. Based on the dimensions provided by Hu et al (1999), the factors influencing end user acceptance were grouped and will be discussed under the following headings:

- Technology factors
- Social factors
 - Individual differences
 - Group differences
 - Nursing culture
- Organisational factors
 - System in the context of the process
 - Project management
 - Management commitment

2.3.1 Technology factors

A common theme that underlies the most prominent models investigating the acceptance of new technology is end user perceptions of the technology as key independent variable.

For example, in Rogers' diffusion of technology theory, perceptions are regarded as an important antecedent to the decision to adopt the technology.

In both the TAM (Technology Acceptance Model) (Davis, 1989) and its precursor the theory of reasoned action (TRA), beliefs (or perceptions) about the technology are instrumental in attitude formation and eventually in system utilization.

The TAM appears to be the most widely applied model of end user acceptance and usage (Ma & Lui, 2004) and is also the most accepted among information systems researchers (Agarwal & Prasad, 1998). Due to this wide application and acceptance, the TAM will be the model on which the technology analysis will be based.

The technology acceptance model proposes that perceived ease of use and perceived usefulness predict the acceptance of information technology.

The TAM have undergone testing by many authors (Adams et al., 1992; Davis, 1989; Davis et al., 1989; Davis, 1993; Hendrickson et al., 1994; Igbaria and Iivari, 1995; Keil et al., 1995; Lu and Gustafson, 1994; Mathieson 1991; Segars and Grover, 1993; Szajna, 1996; Taylor and Todd, 1995a) since it was developed by Davis (1986) and is one of the most

influential research models in studying the determinants of IT usage for different information technologies. (Ma & Lui, 2004; Chau, 2001; Agarwal & Prasad, 1998).

The TAM is part of the group of theoretical models that attempt to explain the relationship between end user attitudes, perceptions, beliefs, and eventual system use. Other theoretical models in the group include the theory of reasoned action (TRA, Ajzen & Fishbein, 1980) and the theory of planned behaviour (TPB, Ajzen & Madden, 1986) (Chau, 2001).

The fundamental intention-based theory (on which the TAM is based), the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), describes how beliefs influence attitudes, which in turn shape intentions, which then guide or dictate behaviours. (Chau & Hu, 2001).

According to Chau & Hu (2001), the TAM was developed specifically for explaining and predicting individual acceptance of computer technology (Davis, 1989; Davis & Bostrum, 1993), which makes a good argument for its use in the proposed research. As a model, the TAM attempts to explain and predict the determinants of individual behaviour toward a system, through its manifestation in system utilization (Agarwal & Prasad, 1998).

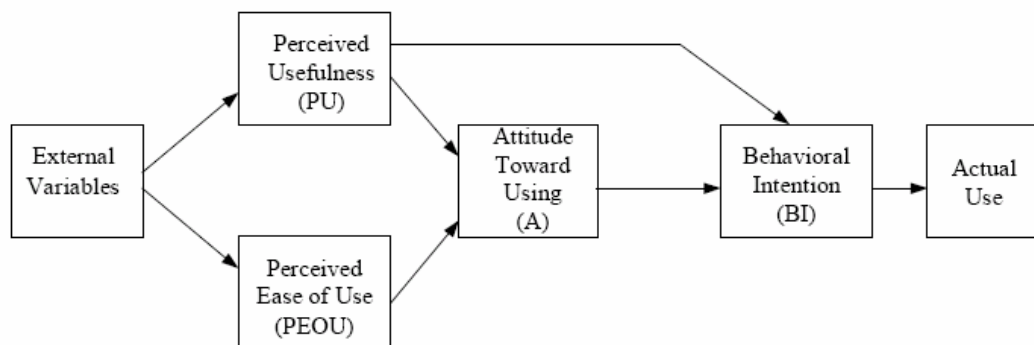


Figure 1: The Technology Acceptance Model (TAM)

As can be seen in the figure of TAM above (Malhotra & Galletta, 1999), the two beliefs, perceived usefulness and perceived ease of use, are instrumental in explaining the variance in potential adopter's attitude towards using technology. (Agarwal & Prasad, 1998) In other words, the prospective end user's attitude reflects his/her perceptions about the system's usefulness and ease of use. (Boonstra, 2003)

Chau (2001) states that, "(the) TAM postulates that IT usage is determined by a behavioural intention to use a system, which is jointly determined by a person's attitude toward using the system and its perceived usefulness. This attitude is in turn jointly determined by perceived usefulness and perceived ease of use. Finally, perceived usefulness is influenced by perceived ease of use and some external variables." (Chau, 2001: page unknown)

The two beliefs, Perceived usefulness (PU) and Perceived ease of use (PEOU) are defined by (Agarwal & Prasad, 1998) as follows:

"Perceived usefulness captures the extent to which a potential adopter views the innovation as offering value over alternative ways of performing the same task."
(Agarwal & Prasad, 1998:18)

"Perceived ease of use encapsulates the degree to which a potential adopter views usage of the target technology to be relatively free of effort (Davis et al., 1989)." (Agarwal & Prasad, 1998:18)

2.3.2 Social factors

Individual differences

Variables related to individual differences are not included in the TAM (Agarwal & Prasad, 1998). These form part of external variables and Agarwal & Prasad (1999) theorizes that individual differences exhibit an influence on individual behaviour toward new information technology via their effects on an individual's beliefs about the new IT (Agarwal & Prasad, 1999)

These individual differences refer to end user factors that include traits such as personality and demographic variables, as well as situational variables that account for differences attributable to circumstances such as experience and training (Agarwal & Prasad, 1998).

Agarwal & Prasad (1998) also describe how a parallel stream of research in new information technology implementation has also posited and verified significant relationships between individual differences and various outcomes associated with new technology acceptance. In their view, Agarwal & Prasad are of the opinion that there is a lack of attention to individual differences in models such as the TAM (Agarwal & Prasad, 1998).

In the original TAM, Davis et al. (1989) suggested that the internal psychological variables (or the so called beliefs), that are central to TAM, fully mediate the effects that all other variables in the external environment may have on an individual's use of an innovation. (Agarwal & Prasad). The full mediation provided by beliefs and attitudes implies that all external variables would not exhibit any direct influence on usage intentions or usage behaviour and that the effects would only be exhibited indirectly through their relationship with beliefs (Agarwal and Prasad, 1998).

It thus appears that although individual differences might be present, according to the literature (TAM), they are fully mediated by the beliefs present in the model.

In conclusion, the pathway of the variables representing individual differences is

- exogenous to the conceptualization of TAM and
- the research done by Agarwal and Prasad (1998) theorizes that individual differences exhibit an influence on individual behaviour toward a new information technology via their effects on an individual's beliefs about the new IT.

Chau (2001) categorizes external variables into 2 categories, namely “demographic variables” and “belief and attitudinal constructs”.

While “demographic variables” are what the category name implies, Chau (2001) provide self-efficacy and computer attitude as external variables that fit into the “belief and attitudinal constructs” category.

The importance of individual differences, as part of exogenous variables, stems from the fact that they represent an important channel through which management can influence the formation of the beliefs found in the TAM.

Individual differences and other external variables might not only be an *important* channel, but because the remainder of the technology acceptance processes are hypothesised to be

a processes not amenable to direct manipulation, it might be the *only* channel is at management's disposal to influence behaviour (Agarwal & Prasad, 1999).

"Attitude" is an important individual factor identified by Chau & Hu (2001) in a study investigating doctor IT acceptance. "Attitude" is defined by Ajzen and Fishbein (1980:28) as "an index of the degree to which a person likes or dislikes about the object". In Chau & Hu's (2001) view "attitude" plays a crucial role in technology acceptance by individual professionals. The importance of "attitude" lies in the fact that it might be a characteristic potentially differentiating doctor's decision-making processes from those of user populations found in business settings (Chau & Hu 2001). They attributed that this observed importance of attitude might be, in part, due to specialised training, autonomous practice, and professional work arrangements. Specialised nurses like intensive care unit (ICU) nurses work in similar environments as described above and the possibility that the "attitude" factor also influence their IT acceptance can not be excluded.

Concerns regarding technology in the nursing environment cover a broad range of issues. Some studies revealed that long-term, loyal employees do not believe that technology will increase efficiency (McConnell, 1989) while other studies have found that participants felt that computers posed a threat to their individuality (McConnell, 1989).

In a study at a hospital in the USA investigating, among other things, staff attitudes regarding computers, it was revealed that registered nurses generally were undecided about their attitudes toward computers. The nurses who had worked at the hospital longer agreed that computers improved the quality of patient care, but also felt that computers dehumanized patient care (McConnell, 1989).

The age of IS users also appears to play a role in nurse's attitudes towards computers and computerisation (Hebert & Benbasat, 1994).

In a study done by McConnell, as the age of the staff nurses in the study increased, the more they felt that computers increased the amount of time they had available to spend with patients (McConnell, 1989).

In contrast, Bartholomew found that older nurses have long-established practice patterns and habits and may often view new technology as something that distract them and take their attention away from their patients (Bartholomew & Curtis, 2004).

Bartholomew describes how the average nurse is 44 years old and that this has a direct impact on technology usage. In nurses' experience, for example, computerized charting

took longer to do than paper charting, and in the past, they were correct. Many systems were initially designed so that every single field needed completion, which required more time (Bartholomew & Curtis, 2004).

Attitude and age are not the only individual differences influencing technology acceptance. Agarwal & Prasad (1999) found that individuals with a greater familiarity with technology in general, those with higher educational levels, and those who have greater prior experiences with similar technologies are more likely to have positive beliefs about new technologies (Agarwal & Prasad, 1999). Educational preparation and length of service in the nursing profession are other variables often considered in studies assessing nurses' attitudes towards computers (Hebert & Benbasat, 1994).

Group differences

Even within healthcare there are differences between different user group perceptions. Many of the clinical information systems designed for healthcare are designed specifically to aid the doctor community. These doctor focused software designs generally came about in an attempt to address concerns regarding patient safety (Bartholomew & Curtis, 2004). Software vendors haven't dedicated sufficient time to research and analyse the software nurses need to support them in their nursing practice. Therefore, nursing hasn't had a sufficiently active role in product development and manufacturers haven't designed clinical systems to support nurses' workflow (Bartholomew & Curtis, 2004).

The type of nursing unit is also a factor that has been considered in the past to explain differences in information system acceptance among nurses (Herbert & Benbasat, 1994). With reference to the fact that the 'attitude' characteristic might differentiate doctors from other end users due to specialized training, autonomous practice, and professional work arrangements, (as mentioned above) it seems logical to consider the fact that it also might apply to some nurses. Nurses, like ICU nurses, are also exposed to similar working conditions, training and autonomous practice and the possibility exists that the "attitude" characteristic might also differentiate them from other end users in the same environment.

Therefore individuals not only differ from each other in the way they accept an information system, but doctors also differ from nurses and groups of nurses might also differ from each other to the same extend.

Nursing Culture

What is nursing culture and how does it differ from how doctors practice?

Doctors focus on treating specific diseases while nurses play a much more holistic role in the management of patient recovery and wellness (Simpson, 1998). In healthcare this "caring" aspect is unique to nursing and its value to patient care secures nursing's place in the healthcare equation (Simpson, 1998). As a result nurses and doctors practice and think differently and the information systems they use are also different (Simpson, 1998).

In a round-table discussion, nurse leaders revealed that cultural and societal factors may play a larger role in nurses' willingness to embrace a CIS than attitudes toward computers themselves (Kirkley, 2004). Even in the context of the fact that resistance to change is a natural human behaviour, it is felt that there are additional factors at play in the nursing profession which impede the adoption of IT (www.pdacortex.com, 2001).

Other factors that might also influence IT acceptance by nurses are the following:

- 1) An aging population of nurses who have had little or no training in the use of information technology
- 2) Insufficient technical training at the baccalaureate level
- 3) A false perception among nurses that IT is "dehumanizing"
- 4) Misconceptions about hardware functionality (www.pdacortex.com, 2001).

The caring culture

Bartholomew describes nurses' resistance to new technology as disheartening and ask the question as to why as a profession, have the nursing community historically supported the adoption of technology that benefits patients, but are not pushing forward technology that helps nurses? She (Bartholomew & Curtis, 2004) further states that it is ironic that while nurses demand new technology, they actively resist it and mention reports that showed how nursing resistance alone has caused the death of numerous IT initiatives.

The answer might lie in the fact that nursing is the archetypal female role and care is nursing's core task (Wilson, 2002).

The role played by gender in the demise of the information system in the case described by Wilson is both fundamental and indirect. In this case the nurses were confronted with the choice of delivering care or perform the task of interacting with (alien) technology. Wilson describe how the dominant (female) culture at ward level prioritised physical proximity to the patient and a caring approach. The hostility that developed towards a care planning

system was thus due to the fact that it took nurses away from hands-on care (Wilson, 2002).

Hands-on care and interactions with patients gave nurses true job satisfaction and in that regard it is important to ensure they spend more time at the bed side and that they collect the data where it is generated (Korth, 1993).

But how much time do nurses spend on caring for patients and how much do they spend on other tasks?

In studies done in the mid-1990s, nurses provide less than one hour of direct care to their patients in a 12-hour period (Bartholomew & Curtis, 2004). The remainder of their time was spent managing and coordinating communication to other parties involved in patient's care. Other research has shown that documentation related tasks consume from 40% to 60% of the nurses' time (Meyer, 1992).

IT has the ability to change the nursing profession dramatically and to allow nurses to practice and focus on knowledge rather than on tasks (Bartholomew & Curtis, 2004).

The problem is that the technology nurses are currently using was not designed to support nurses in the care of patients, but rather to support them in the collection of patient data (Ellis, 2000). Technology has thus directed attention away from the patient and onto itself with the result that a separation is developing among the nurse, the healthcare team, and the patient (West, 2003).

In the context of the caring culture practiced by nurses, information technology thus appears to be preventing them from caring properly for their patients.

Time & Workload

Long hours and increasing patient loads are common issues facing nurses that work in areas like ICU or do medical or surgical nursing (Burda, 2004). If nurses have to, due to a shortage of time, choose between giving hands-on care or writing records, they will choose providing care (Wilson, 2002).

In a case described by Wilson, nurses was promised that the implementation of an IS will reduce the nurse's administrative workload, freeing the nurses to deliver better quality patient care. This never happened and with the nurses working a dual system, they had double the administration workload (Wilson, 2002). Although the increase in workload was due to the continued use of the paper system, for nurses the paper system was the record to trust and the anchor to their work (Wilson, 2002).

It is thus clear that when under time or workload pressure, nurses opt to focus on patient care and stick with the processes that provide them with tried and trusted outcomes.

In conclusion, nursing is an environment dominated by females with an accompanying caring culture. And although caring is the part of their work that they consider most important, they spend most of their time doing administrative work.

Time constraints and work overload put further pressure on their ability to deliver nursing care as intended and when under pressure, nurses opt for the system that they can trust.

2.3.3 Organisational factors

The successful implementation of information systems in healthcare organizations depends heavily upon integrating these systems into complex, organizational settings (Anderson, 1997).

System in the context of the process

When the implementation of information systems into health care settings interferes with traditional practice routines, it is unlikely that end users like doctors will accept it. The problem with this system rejection is that it will deprive the organization of benefits that can only come about through system utilization (Anderson, 1997).

The problem with poor IS integration into clinical practice is that it can be counter productive. This counter productivity is the result of poorly integrated information systems that work against the productive collection and application of clinical information (Sensky, 2002). One such a way in which a poorly integrated IS can be counterproductive is increasing the workload (Kuhn & Guise, 2001). Doyle (2002) provides an example of the latter when he describes an increase in physician workload due to the information system in the hospital where he practices.

The understanding and improvement of clinical processes play an important role in making CIS implementations successful. In a discussing on the implementation of a CIS in critical care, Meadows (2003) is of the opinion that to ensure success in implementation, the right CIS must be carefully selected to address the unique needs in this area (Meadows, 2003). The improvement of workload appears to be quite a challenge to system implementers and Kuhn & Guise (2001) described how this challenge consists of two aspects.

The first aspect lies in how information systems need to be adapted to the work practice and workflow, and the second in how the workload must be reduced or simplified (Kuhn & Guise, 2001).

This adaptation of work practices is necessary for effective technology transfer in healthcare organisations and it is likely that work practice adaptation might be far beyond what is initially apparent, particularly for an activity such as medical practice and especially when the organization is large (Southon et al., 1997).

The implementation of a IS can help healthcare organizations align their work activities through the technology's ability to transform the organization during the implementation process. (Berg 1999) Through poor integration the organization might lose the possible benefit of work activity alignment. The co-ordination of work activities in healthcare appears to be more important than in other industries due to increasing pressure to increase quality of care to patients without increasing the costs (Stefanelli,2002).

Project management

Project management plays an important role in the success or failure of information systems in general (Sauer, 1999) and this is also the case in implementing clinical information systems (Bennett, 1993; Ash, Stavri, & Kuperman, 2003; Page, 2000).

Change

End user resistance to change is a important factor to which many IS implementation difficulties have been attributed (Jiang et al, 2000).

One of the major problems for project managers is the management of cultural change that may be induced by the system implementation (Perry, date unknown).

Without the proper management, the system may provoke an adverse reaction from staff who may either reduce the system's effectiveness through modification, or by total rejection of the system (Perry, date unknown; Cooper, 1994).

Not only can the system implementation conflict with the organizational culture but expectations around IS implementation might also be unrealistic (Simpson, 1996). The people factors behind these unrealistic expectations stem from the fact that people do not understand that business processes have to be re-engineered, which include a request to healthcare personnel at all levels of the organization to modify their behaviour, and that

both time and commitment need to be made to the project over the long term (Simpson 1996).

It therefore appears that change will be needed in business processes, personnel behaviour, time and commitment to support the implementation. Key executives need to address these considerations if they do not want the implementation to suffer (Simpson, 1996). Manzoni & Angehern (1998) also warn that “whenever processes are redesigned or the availability of information is modified, work habits must be changed, existing social patterns are threatened, and the power and influence structure that has slowly evolved over time can be abruptly destabilised. “ They (Manzoni & Angehern, 1998) advise that managers must require a sound understanding of the organizational implications of implementing new technology-based systems and of the strategies and tactics to be applied in order to reduce resistance to change.

It thus seems that the changes that accompany the implementation on both a cultural and organizational level also need to be well managed in order to decrease resistance and ensure the likelihood of a favourable outcome.

Other factors researchers identified as sources of employee attitudes toward change include individual characteristics, ease of use and usefulness, prior expectations, magnitude of the change, equity perceptions, and the dynamics of implementation as a political process (Jiang et al, 2000). One can only guess how individual characteristics, perceptions and expectations will be much more difficult to manage than the change process on an organizational level.

Communication

The importance of communication as a critical success factor during implementation of IS is mentioned by authors like Page (2000) and Lorenzi & Riley (2000).

There should be effective communication between the nursing leadership and the end users, (Page, 2000) and also between individuals who share the same professional culture and work environment (Barr, 2002).

Page (2000) advises that a comprehensive, integrated communication plan must be established to identify the individuals who will be affected by the implementation process (the target audience). Key messages should be targeted toward this audience and ways

should be developed to incorporate input from the target audience. The input will result in the individuals increased participation and support due to a sense of ownership (Page, 2000).

An example of good co-operation resulting from good communication between management and staff come in the form of shared governance, where staff nurses are involved in all decisions that impact nurses in the environment of their practice (Korth, 1993). This shared governance is established in the form of a “horizontal link” where staff nurses’ representation is present on all forums, committees or task forces whose decisions will have an impact on the delivery of nursing care (Korth, 1993). In the example provided by Korth, communication between end users (in this case registered staff nurses) and the information services in the hospital became truly open as each group began to understand the other’s terminology and needs (Korth, 1993).

Decision involvement

User involvement, (Sauer, 1999; Bennett, 1993; Ash et al, 2003) and the inclusion of key stakeholders (Meadows, 2003) are very important and these groups should be involved even before the decision regarding the software and hardware is made (Page, 2000).

The committee members involved in the decision-making must have a sound knowledge of both information systems and the end users’ perspective of healthcare delivery. The need for staff nurses to be active committee members can therefore not be overstated and without their representation, a skewed picture of the institution’s healthcare delivery process would result (Williams & Brown, 1994).

Involvement of key stakeholders (medical staff and doctors) for such an enormous organizational change will achieve buy-in, especially because it will influence their daily workflow (Page, 2000).

Training and support

Nurses need appropriate educational training to enable them to use IT adequately (Alpay & Russell) Training and support are seen by many as part of the critical success factors of CIS implementation (Bennett, 1993; Meadows, Ash et al, Littlejohns, 2003; Ferrell & DeBord, 2003; Lorenzi and Riley, 2000; Eger et al, 2001).

Training enriches the end user’s IT knowledge and experience (Leonard-Barton 1987) and has been identified as one of the key factors responsible for ensuring successful IT usage (Venkatesh,2002; Davis & Bostrom, 1993; Nelson & Cheney, 1987).

Management commitment

The importance of both the involvement of the chief executive officer (CEO) and executive leadership in clinical information system implementation is stressed by Page (2000).

He (Page, 2000) describes how the vision and value of the CIS project should be communicated through to the staff by the CEO and how the CEO should arbitrate major conflicts between the physician community and various hospital disciplines. He continues by saying that this CEO-doctor relationship is vital to the project and closely ties in with the communication and change management concepts that were discussed in the previous project management section (Page, 2000).

Thus, not only are effective communication and change management important on a project level, but should also be a priority on a top management level.

Page also discusses the involvement of what he calls a “nurse executive”. The nurse executive will ensure adherence to the clinical information system vision and will also make sure that all available resources are harnessed in overcoming major obstacles. By getting nurses more involved in both designing and implementing clinical information systems, the systems stand a better chance of being accepted and used (Burda, 2004).

Page stresses that leadership skills in negotiation and conflict resolution (in these projects) will become increasingly critical (Page, 2000).

Management commitment as part of successful IS implementation is also seen as important by Sauer (1999) and more specifically to clinical information systems by Bennett (1993) and Littlejohns (2003).

3. RESEARCH PROPOSITIONS

In an attempt to address the problem and its sub problems the following research propositions flowed from the literature review.

3.1 Research proposition 1

The acceptance of clinical information systems by end users is influenced by one or more of the following factors:

- Technology factors
 - Perceived usefulness
 - Perceived ease of use
- Social factors
 - Individual differences
 - Group differences
 - Nursing culture
- Organisational factors
 - The fit between the system and work processes
 - Project management
 - Management commitment

3.2 Research proposition 2

Individual end users of a clinical information system differ in their acceptance of clinical information systems due to:

- individual differences
- differences in work environments

4. REASEARCH METHODOLOGY

4.1. Introduction

In information system (IS) research, there has been a shift in interest, away from technical to the more organisational and managerial issues. (Myers, 1997)

This shift has brought about an increasing interest in the application of qualitative research methods in studying information systems. (Myers, 1997)

The objective, inanimate symbolic forms in which IS trade, requires human thought in order to “exist” in any useful sense of the word (Thompson, 2002). It is therefore interesting to note that according to Walsham (2001), there has been a lack of in-depth IS research conducted at the level of the individual.

Thompson (2002) advocate that if researchers in this field want to approach the inter-linkages between humans and the wider IS with any clarity of focus, they should locate themselves down at the level of individuals' generation of meaning (Thompson, 2002).

With that in mind the following research method was chosen as described below.

4.2 Research method

The research problem described in the first section required the researcher to look in depth and get complete understanding of the situation at the Flora Clinic Hospital. According to Leedy & Ormrod (2001) this complete understanding of the research problem lends itself well to the conducting of *qualitative research*.

Qualitative research made it possible to construct a meaningful picture of the complex situation with its many dimensions and layers at the Flora Clinic Hospital.

The researcher kept in mind that there was a possibility that this qualitative study would evolve over the course of the investigation as described by Leedy & Ormond (2001).

Walsham (1995) is of the opinion that organisational issues are important in the context of computer-based information systems and in order to increase our understanding of these organisational issues, he propose the use of *interpretive methods* of research.

(Walsham ,1995, p 2)

Not only will these interpretive methods produce an understanding of the context of the information system, but will also provide understanding of how the IS influences and is influenced by the information system. (Walsham ,1995, p 3)

Interpretivism as epistemological position is

“...concerned with approaches to the understanding of reality and asserting that all such knowledge is necessarily a social construction and thus subjective” (Walsham ,1995, p 5)

Myers (1997) argues that by using interpretive studies, the researcher generally attempt to understand phenomena through the meanings that people assign to them.

Between the qualitative designs available, (case study, ethnography, phenomenological study, ground theory study and content analysis) the *case study method* was deemed most applicable in solving this specific research problem.

This method allowed for this case to be examined in its natural setting by using more than one method of data collection.

Myers (1997) is of the opinion that since the object of the discipline is the study of information systems in organizations, the case study research method is particularly well suited to IS research.

Based on the literature, the most suitable approach in conducting this research was qualitative research in the interpretive paradigm through the case study method. The research method will now be discussed in more detail below.

4.2.1 Qualitative research

The method of qualitative research described by Leedy & Ormrod (2001) requires the researcher to be an instrument and to maintain objectivity. According to Leedy & Ormrod (2001) all qualitative approaches have the following two things in common. They focus on phenomena taking place in natural settings and they involve studying those phenomena in all their complexity.

While conducting this research the researcher acknowledged and attempted to maximize his understanding of social phenomena in order to try and uncover the multiple perspectives held by individuals (Leedy & Ormrod, 2001).

The reason(s) as to *why* end users accepted or rejected a CIS in a healthcare environment was examined thoroughly in an attempt to try and obtain a deeper understanding into possible answers to the research problem.

In order to do that the researcher needed to acknowledge any inherent biases that could influence the interpretation of the research.

4.2.2 Interpretative paradigm

Orlikowski and Baroudi (1991) identified three broad research philosophies, positivist, interpretivist and critical. (Walsham; 1993, p 246).

Walsham (1995) states that historically in IS research, the only acceptable approach was positivism and how in recent years there has been a marked change towards the interpretive methods of research. (Arvela, date unknown)

One of the key findings in a study by Myers (1994) is that information system implementation can only be understood as part of the broader organizational and social context.

Thompson (2002) advise that when interpretive research is conducted in IS, the focus should be on the individual's knowing of the IS rather than the social role that he / she plays in the context of the IS.

The interpretive method of research then, is aimed at an understanding of the IS and the process of mutual influence between the system and its context and appears to be appropriate in conducting the proposed research.

The research was conducted in order to solve the problem stated in the first section and was done under the following assumptions about the nature of social science:

Ontological assumptions:

The nominalistic assumption is made with the world not existing independently of the observer.

Epistemological assumptions:

In research, positivist studies generally attempt to test theory, in an attempt to increase the predictive understanding of phenomena (Myers,1997). In these types of studies it is generally assumed that reality is objectively given and can be described by measurable properties which are independent of the observer and his or her instruments (Myers,1997). This research will not be done to add predictive value and no measurements took place. The research will therefore be non-positivist in nature.

Assumptions of human nature:

This research will be based on the assumption that people's actions can be determined.

Methodology assumptions:

In order to understand the phenomenon in its context, the ideographic case study will be used.

4.2.3 Case study method

The case study method was used in the conduction of this research.

Yin (1994) provides a technical definition of a case study when he states that a case study is an empirical inquiry:

- that investigates a contemporary phenomenon within its real-life context
- where the boundaries between phenomenon and context are not clearly evident and
- where multiple sources are used.

Leedy & Ormrod (2001:149) describes a case study as follows:

"In a case study, a particular individual, program or event is studied in depth for a defined period of time."

General case studies are the preferred method when "how" and "why" questions are being posed, when the investigator has little control over events and when the focus is on a contemporary phenomenon within some real-life context (Lubbe, Date unknown; Yin, 1994:p.13).

While conducting this research it was kept in mind that most cases are aggregates of complex behaviour as described by Stake (1994).

The ability of the case study method to address the 'why questions' of a phenomena of IT within the organizational context by making use of multiple sources of evidence, made it particularly suitable as a research method in addressing this research problem.

For the purpose of this research the single case study method, using embedded units of analysis, was used.

4.2.4 Problems with the case study method

The following problems are present when doing case study research

1. They have a potential for bias
2. They provide little basis for scientific generalization
3. They take too long and result in massive, unreadable documents.

(Yin, 1994: p.13)

Although most researchers strive to be objective in their research, the problem of bias in research cannot be totally eliminated but its implications should be accepted and acknowledged. (Leedy & Ormrod, 2001; Lubbe, Date unknown).

Lubbe (Date unknown) also states that with regards to research findings, these findings should be honestly presented and not presented in such a way as to simply support the opinions of the researcher.

Yin (1994) states that from the above mentioned problems the most important lesson is that a good case study is difficult to do and reminds the researcher that he/she must exercise great care in designing and doing case studies in order to overcome the traditional criticisms of the method. (Yin, 1994: p.13)

In the conduction of this research, these problems mentioned in the literature were kept in mind.

4.3. Case site

Babbie & Mouton (2001) describe how it is rare that the unit of analysis in case study research is unaffected by factors from the environment in which it is embedded.

They quote Meyer (1983) who describes how the surrounding environment and its systems help contextualize the context in which the unit of analysis lies. (Babbie & Mouton, 2001)

The case site identified for this case study is the Flora Clinic Hospital in Roodepoort, Gauteng, South Africa. The hospital forms part of the Life Healthcare Group (LHCG).

The Flora Clinic Hospital functions as one of the flagship hospitals in the LHCG and was chosen for the POC implementation based on the fact that if it was successful in this hospital, it would be able to implement the POC system to all other hospitals in the group (A. Daneel, personal communication, 4 November 2004).

4.4. Research design

According to Yin (1994), a research design is “the logic that links the data to be collected to the initial questions of a study” or in other words an action plan to get from the initial set of answers to some set of conclusions.”

Yin also provide a quote from (Nachmias and Nachmias, 1976 pp. 77-78) who describe a research design as a plan that “ guides the investigator in the process of collecting, analysing and interpreting observations.”

Yin sees the main purpose of the research design “to help to avoid the situation in which the evidence does not address the initial research process.”

Yin further breaks down research design into 5 important components:

1. the study's questions
2. it's propositions
3. it's units of analysis
4. the logic linking the data to the propositions
5. the criteria for interpreting the findings

The components mentioned above will be applied as follows:

- The study questions have already been described above.
- The two study propositions that have been stated earlier will guide the researcher when conducting the interviews and collecting other data.
- The unit of analysis or “case” will be CIS end user acceptance decisions as described earlier.
- Pattern matching as described by Yin (1994, p. 25) will be used to link the data to the propositions.

4.5. Data collection

The process of data collection for the research included open ended interviews, relevant documents, observations by the researcher and historical records. In collecting the research, the researcher created opportunity for the further discovery of data by keeping an open mind toward new avenues of acquiring data.

Rowley (2002) argues that if one compares the case study method of research to other research methods, one of the great strengths is that it allows for evidence to be collected from multiple sources. These multiple resources form the concept of triangulation as described below.

4.5.1 Triangulation

Human (2003:54) best describes triangulation as follows:

Triangulation arises from the need to confirm the validity of the research process (Stake, 1995). It allows for the use of data from multiple sources, each of which may possess different types of errors or weaknesses, to ensure that a more objective understanding of the data can be obtained across the different sources and therefore to assist in data convergence (Yin, 1994).

By using triangulation an attempt was made to address the problem of construct validity as described in more detail later on.

Babbie & Mouton (2001) point out the importance of using multiple sources of data in case studies of all kinds. They further state that using multiple sources of evidence is based on the ideas of replication and convergence. They describe how replication can increase the confidence the researcher has that his/her findings are reliable.

4.5.2 Data collection through interviews

Interviews formed the main source for the collection of data and were done on location at the Flora Clinic with the exception of three of the interviews. These were the two interviews with the Point of Care (POC) project team member done in Bedfordview and Rosebank and the interview with the POC project manager done in Bedfordview. (See Appendix A)

Within the cluster of clinical information system end users, random sampling was done in order to acquire subjects for the open-ended interviews.

This was done from a practicality point of view in that healthcare personnel work in shift patterns and it was impossible to determine which personnel would be available at a specific time to grant an interview.

Although the questions in the interviews was constructed in such a way that it allowed the interviewee to give an uninfluenced response to questions regarding the research problem, additional questions to interviewees was sometimes necessary as the study progressed. Interviews were recorded, transcribed and then stored in electronic format.

Interviewees included,

- multiple end users of the information system at the Flora Clinic Hospital,
- members of staff from the information and communications technology department at the hospital and at Afrox Healthcare head office
- members of the top management of the hospital.

By covering people with different views on the information system an attempt was made to get data that are more objective in nature, as described in the section on triangulation.

4.5.3 Data collection through other sources

To reinforce or contradict the data collected from the interview process relevant documents were requested from interviewees if applicable.

The researcher also did observations, while on the premises of the hospital, in order to get supportive data to that obtained through the interviews.

An active attempt was also made to obtain any historical documentation from sources other than interviewees.

These additional sources included POC project reports and evaluations, information leaflets, internal posters, emails and power point presentations on the POC project.

4.5.4 Data storage

Databases as well as field notes were used to categorize and reference data in order to make it readily available for re-interpretation.

The less formal method of field notes data storage was used in order to record feelings and intuitive hunches, record questions that developed from the interview and document the work in progress.

4.6 Data analysis and interpretation

Yin (1994) states that data analysis consists of recombining the evidence acquired to address the initial propositions of a specific study.

The researcher acknowledges that the analysis of case study evidence is one of the most difficult aspects of using the case study as research methodology. (Yin, 1994).

Babbie & Mouton (2001) state that the analysis of a case study involves the following:

- how to organize the findings
- the question of whether generalisation is appropriate to the case study data and
- the issue of theory development

The organisation of the data describes the need for developing clear categories for the empirical data that will provide a focus for the findings. (Babbie & Mouton, 2001)

Babbie and Mouton (2001) also describe how the generalisability of the findings is demonstrated by showing the linkages the findings and previous knowledge.

Case studies also have great potential for theory development. (Babbie & Mouton, 2001)

4.6.1 General strategy

The analytical strategy of relying on theoretical propositions as describe by Yin (1994, p. 103) was used in this research as a general strategy. By following this strategy the propositions as described in section three were followed.

4.6.2 Pattern matching

Yin (1994) describes how given a general strategy three specific analytical strategies can be used. These strategies are pattern matching, explanation building and time series analysis.

Yin (1994) describes pattern matching as a technique where an empirical based pattern is compared with a predicted one.

In this research the logic of pattern matching was used to analyse the evidence obtained through the data collection process.

4.7 Quality of the design

Yin (1994, p.32) describes four tests that are used to establish the quality of empirical social research of which case studies form part. These tests are construct validity, internal validity, external validity and reliability.

With regards to the validity of case studies Lubbe (Date unknown:10) makes the following statement

“When a case study is carried out both systematically and critically and aimed at the improvement of understanding, then it is relevant, and if any publication of its findings extends or expands the boundaries of existing knowledge of the subject area, then it is a valid form of research.”

4.7.1 Construct validity

Yin(1994) defines the concept of construct validity as establishing the correct operational measures for the concepts being studied.

In order to overcome the problem in this case study of construct validity, that is common in most case studies, multiple sources of evidence were used during the data collection.

4.7.2 External validity

Yin(1994) refers to external validity as knowing whether a study's findings can be generalized beyond the specific case study.

According to Leedy and Ormrod (2001) the case study method is useful when a hypothesis is to be generated or support is needed for a certain hypothesis but that its main weakness is that results obtained from a single case study are not always generalizable to other situations (Leedy & Ormrod, 2001).

In this research an attempt will be made to overcome the problem of generalisability by generalising the findings from this case study to theory.

4.7.3 Internal validity

Internal validity refers to the ability of the case study to show that certain conditions lead to other conditions, or in other words, a causal relationship exists between data elements (Yin, 1994).

In order to overcome the possible problem of internal validity in this research the logic of pattern matching as described above was used.

4.7.3 Reliability

Reliability refers to the extend to which another researcher would draw the same conclusions in the same research proposal (Whittaker, 2003).

According to Yin (1994), the goal of reliability is to minimize the errors and biases in the study.

The use of a case study protocol in this research was used to reduce the problem of reliability.

Yin (p.89) also describes how the principles of

- using a multiple source of evidence (improve construct validity)
- creating a case study data base and
- maintaining a chain of evidence (improve reliability)

can help to deal with the problems of construct validity and reliability.

5. BACKGROUND TO THE CASE STUDY

On the 7th of October 2002, the following statement was published on the Symbol website:

“Symbol Technologies Africa Inc. announced today that Afrox Healthcare Limited has implemented Symbol PPT 2846 Pocket PC mobile computers and Symbol's IEEE 802.22b Wireless Local Area Network at the Flora Clinic Hospital for Point-of-Care applications. The solution will contribute to improved productivity and reduced errors, while increasing the quality of service to patients.”

The Point of Care (POC) project at the Flora Clinic went into pilot phase in October 2002. According to an internal document the objective of the pilot phase was to allow the wards to do ward charging, bed and room transfers and patient discharges on a small hand-held computer. The POC implementation followed a feasibility study that was conducted during June and July of 2002.

5.1. Case site - The Flora Clinic Hospital

At the time of the implementation of the POC system into the Flora Clinic, the Flora Clinic was a 271 bed hospital in the Afrox (now Life) Healthcare Group, situated in Roodepoort in the West Rand area of the greater Johannesburg municipality, Gauteng, South Africa. On the abovementioned Symbol website it was described how the hospital had 10 operating theatres, 4 ICU's (medical, general surgery / cardiothoracic, pediatric and neonatal) and a highly rated trauma and emergency unit.

The rationale to use the Flora Clinic as the pilot hospital was based on the fact that if the POC system worked in a big hospital, it would have been easier for the healthcare group to implement it in their smaller hospitals (A. Daneel, personal communication, 4 November 2004).

5.2. The Point of Care (POC) system

In an information leaflet handed out by the hospital the point of care system was described as a

“..... handheld computer, using radio frequency over a wireless network to give information, enabling the nurse to capture information at the point of care (patient's bedside) “

The information captured by the handheld application was then relayed from the Flora Clinic to the Biztalk server in Bedfordview through Telkom lines (A. Kilian, personal communication, 15 December 2004). Refer to the diagram below

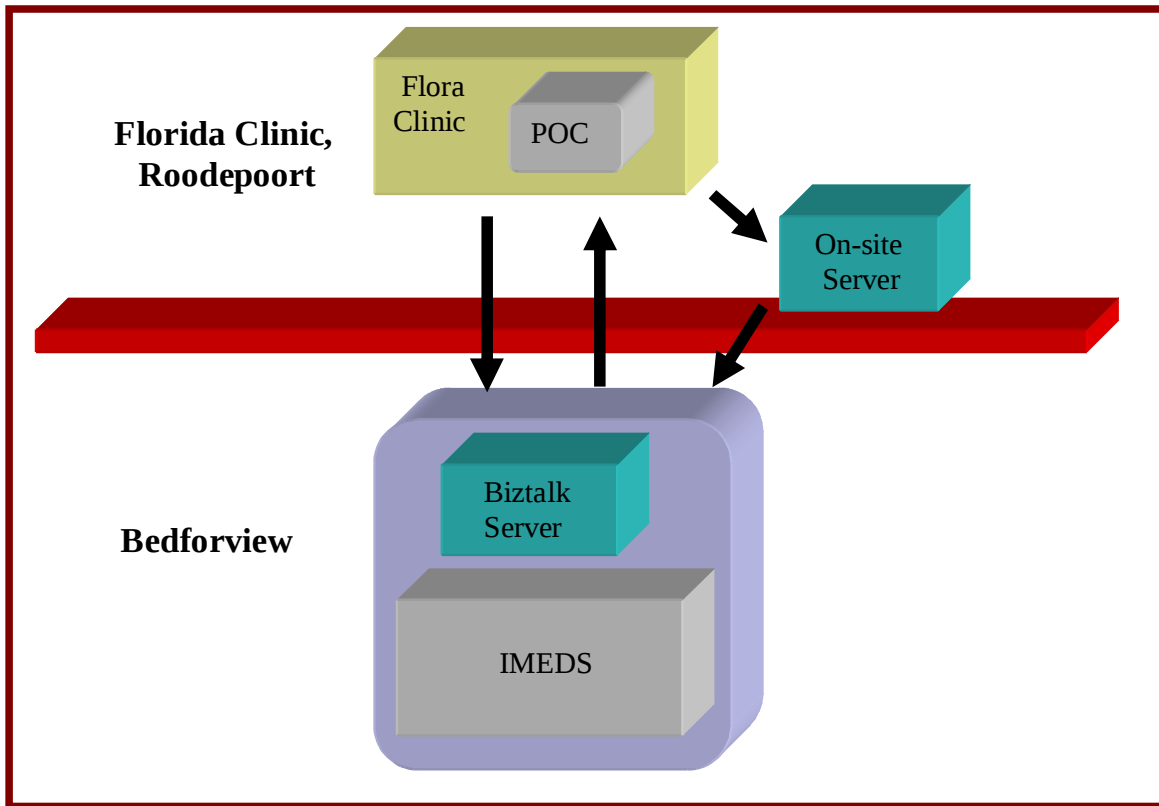


Fig no. 2: Structure of the Point of Care Information System

The manufacturers of the hardware & software were:

Handheld application: Symbol

Server: Biztalk (a Windows Server System product)

Software: iMeds was the software used by the Afrox Healthcare group. The new technology was incompatible with iMeds and new customised software for the POC system had to be developed in-house (A. Kilian, personal communication, 15 December 2004).

5.3. Marketing of the Point of Care system

On an internal marketing Power Point presentation on Point of Care, the POC was marketed as a system that would improve quality for all. It would have benefited the patient, the doctors in the hospital, the community and the hospital itself.

On another internal document in the form of an information pamphlet, the proposed advantages of the POC would have been:

A reduction in administrative overheads by capturing data at the point of care.

Increasing ward and pharmacy efficiency by enabling accurate replenishment of ward stock with minimum delay.

1. Improving productivity of staff by;
 - Reducing paper work
 - Reducing time spent in replenishing of stock – auto replenishment
 - Reducing time spent discharging patient – billing is complete on discharge
2. Benefits for the patients:
 - More time spent at patient's bedside
 - Margin of billing errors reduced, therefore accurate accounts can be delivered
3. Benefits for the hospital:
 - Reducing debtor's delays
 - Reducing margins of error on accounts
 - Reducing time between patient discharge and final bill
 - Reducing funder queries
 - Reducing stock holding
4. Doctors would also spend less time recording charges and more time at patients' bedsides
5. The community would have benefitted by a reduction in paper utilisation
6. Growth and development – keeping abreast of technology

The internal Power Point presentation on POC also stated that in the context of information management in the hospital, the POC device would have enabled the hospital to record information where it is most accurate and deliver that information electronically to where it would be the most useful.

5.4. Point of Care technology and the nursing framework (Power point presentation on POC)

So, what benefits did the new POC system at the Flora Clinic, offer to the nursing staff in particular?

5.4.1 Quality patient care

The delivery of quality care to patients is very important to the nursing community as a whole. The POC would have enabled nurses to spend more time at the patient's bedside, which would have helped them to improve the quality of care they deliver to patients.

5.4.2 Optimal staff utilisation

The POC would have enabled management to utilise staff in the best possible way with nurses spending more time nursing (time at the patient's bedside) and less time doing paper work (completing charge sheets), replenishing stock and discharging patients (bill will already be completed).

This more appropriate utilisation of staff would have contributed to nurses experiencing increased job satisfaction.

5.4.3 Nursing contribution to profit

By using the POC system nurses would improve the billing process, reduce debtor's days, reduce stock holding and improve the accuracy of the final account.

An internal document on the POC protocol stated that from their side, nurses were required, amongst other things, to do the following:

1. To charge all stock used on a patient in the ward, on ward level by using the POC System.
2. To incorporate the POC training of new staff in the orientation programme and to train all others by utilising the buddy system.

5.4.4 Training (A. Daneel, personal communication, 4 November 2004).

All staff were trained on the POC system a week before they had to use the system. This training consisted of one hour of hands-on group training. After all the staff in the ward were trained, the POC system was then implemented in the ward. User training continued through technical support in the form of technical 'handholders' that were placed permanently in the ward. These technical handholders supported the nursing staff until they were comfortable with using the POC system and then moved on to the next ward.

Training therefore consisted of group training one week before the implementation in a specific ward and individual training after the implementation in the ward.

5.4.5 The implementation process

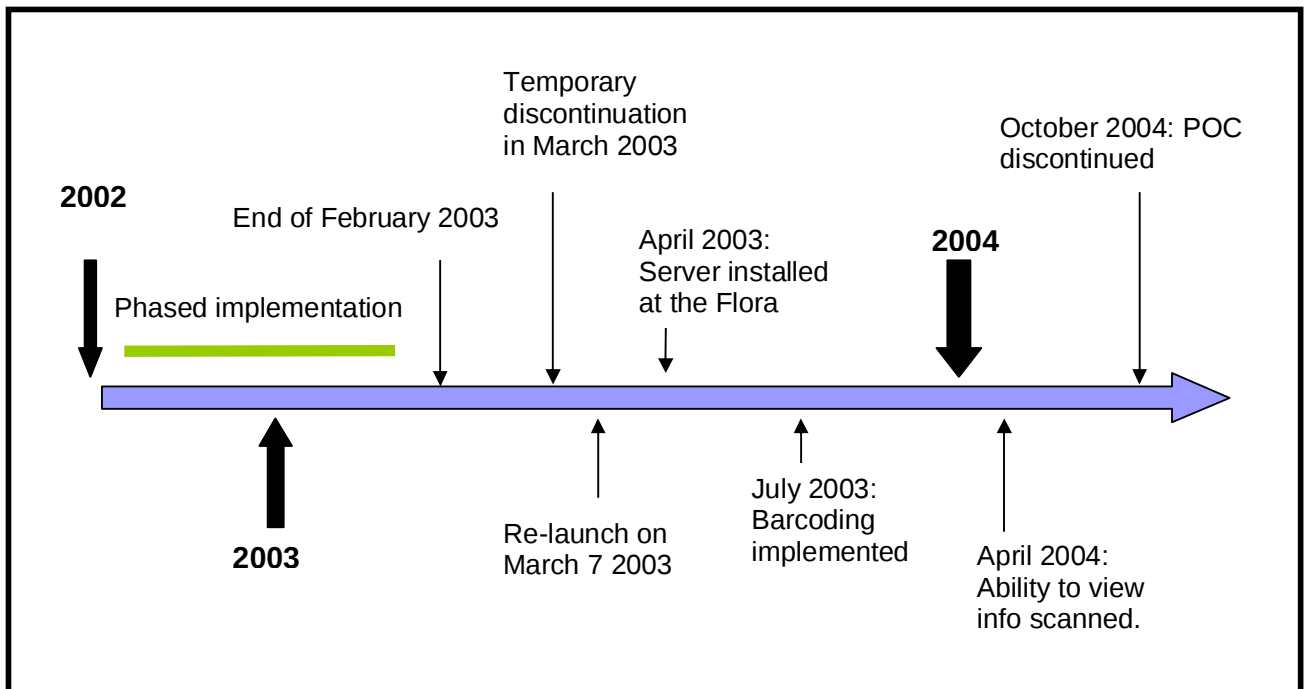


Figure 3: Timeline of the POC system implementation

The roll out

The POC system was rolled out in the beginning of October 2002 with a big-bang launch followed by a phased implementation. The POC had a space-age theme (see picture) and internal marketing to the staff was started a month before the official roll-out (A. Daneel, personal communication, 4 November 2004).

The roll-out strategy was to start with the wards that were the:

1. most efficient in how they functioned
2. least complicated (A. Daneel, personal communication, 4 November 2004).

Within the wards the rationale was that POC use in a specific ward should first be stable (without hiccups) before the implementation moved on to the next ward. In other words management wanted each ward to be successful before they moved on to the next (A. Daneel, personal communication, 4 November 2004).

Programming was done during the implementation and problems were addressed as they presented themselves (A. Daneel, personal communication, 4 November 2004).

The time table of the roll out of the Point-of-Care System (POC) is detailed in table 1 below:

Ward	October 2002				November				December				January 2003				February			
A+GICU	Yellow	Green	Green						Blue	Blue	Blue	Blue								
B+MICU			Yellow	Green	Green				Blue	Blue	Blue	Blue								
OPD				Yellow	Green				Blue	Blue	Blue	Blue								
C+D+PICU					Yellow	Green			Blue	Blue	Blue	Blue								
E+F+G						Yellow	Green		Blue	Blue	Blue	Blue								
H+J+K							Yellow	Green	Blue	Blue	Blue	Blue								
TICU									Blue	Blue	Blue	Blue	Yellow	Green						
RENAL UNIT									Blue	Blue	Blue	Blue	Yellow	Green						
THEATRE 1U									Blue	Blue	Blue	Blue					Grey	Grey	Grey	Grey
THEATRE 2U - 7U									Blue	Blue	Blue	Blue					Grey	Grey	Grey	Grey
THEATRE 8D - 10D									Blue	Blue	Blue	Blue					Grey	Grey	Grey	Grey
SCOPE THEATRES									Blue	Blue	Blue	Blue			Grey	Grey				
TRAUMA									Blue	Blue	Blue	Blue					Grey	Grey	Grey	Grey
CATHLAB									Blue	Blue	Blue	Blue					Grey	Grey	Grey	Grey
CARDIAC REHAB									Blue	Blue	Blue	Blue					Grey	Grey	Grey	Grey
RECOVERY ROOM U									Blue	Blue	Blue	Blue					Grey	Grey	Grey	Grey
RECOVERY ROOM D									Blue	Blue	Blue	Blue					Grey	Grey	Grey	Grey

Yellow	Training completed
Green	Implementation completed
Grey	Training and implementation completed
Blue	Holiday season

Table 1: Roll out of the POC system

According to a project report at the end of October 2003, all the units were equipped with the POC system except trauma, renal and the inpatient units.

The First Month (7 October 2002 to 13 November 2002)

On October 7, 2002, the Symbol website stated that

“The technology has been readily adopted by the doctors and nursing staff at the hospital, which we are confident will contribute to the success of this system at Flora Clinic and other Afrox Hospitals”

In a POC project report it was reported that the implementation into the first few wards (Wards A, Ward B, General ICU and Medical ICU) went smoothly and that in general there was positive response from the nursing staff.

The project management cited the enthusiasm of the process manager and the Flora management as key reasons for this positive response. All four wards showed through statistical measures that they improved both their effectiveness and accuracy of charging with the POC over time. Although there was still a lot of work to be done, the POC application exceeded what project management hoped for in these early stages.

November 2002 to February 2003

In the project report for the time period November 2002 to February 2003, the following were reported.

The effectiveness of the charging in the wards improved from 61% in October 2002 to 82% in February 2003. In the same period the patients discharged from the wards by using the POC system was 87% and in general the use of the POC was seen as very effective. Even at this early stage, certain issues were starting to impact negatively on nursing acceptance of the POC system.

These issues were identified as the following:

1. iMeds response time

During especially the month of February the response time of the iMeds connection was very poor. Due to this the staff in the wards were unable to perform any functions that required a direct connection to iMeds.

2. iMeds reports

POC reports (showing activities done by using the POC system) were printed every morning from iMeds. The printing of these reports was extremely unreliable, with the reports not printing, printing late or printing blank.

3. Biztalk environment

Due to the fact that the components of Biztalk were not monitored properly, they malfunctioned with a resulting negative impact on the update of iMeds. Staff on the ward could not check what they charged and they became very anxious that they were losing their charges.

In general the project team felt that huge progress was made in the initial months of the year but that there was still a significant amount of work that had to be completed. The monitoring of the back-end systems was singled out and it was felt that it needed urgent attention in order to built belief and trust in the POC system.

Hiccups (March / April 2003)

In the period between the implementation and March 2003 the project experienced problems that were mainly due to

- the speed of the hospital processing system (iMeds) and
- the stability and the availability of the messaging layer controlling all the transactions coming from the mobile devices (Biztalk).

In March 2003 the decision was made to temporarily discontinue the POC system as to give the information management department a chance to address and resolve these back-end issues. After the issues were addressed, the POC was re-launched on 7 April 2003.

Improvements

A couple of additions were made to the system in response to problems encountered and lessons learned. The additions were made in order to improve the functionality of the POC system. The additions were the following:

1. Onsite server at the Flora Clinic installed April 2003

This server was installed in order to try and address the connection problems experienced with the Biztalk server situated in Bedfordview.

2. The use of barcodes as means of feeding information into the handheld device was implemented in July 2003. This would have improved the ease of use of the POC system.

3. In March 2004 the ability to view information that was scanned immediately was added to the system. The information was made available from the on-site server and not from iMeds/Biztalk in Bedfordview. The function was added in response to the fact that nurses kept pieces of paper of items charged because they did not believe the item was on the system if they did not see it there. (A. Killian, personal communication, 15 December 2004).

The last project report

In the audit report in an audit done in October 2003, the POC system at the Flora Clinic was deemed to be an efficient system in general but a few areas of concern was

mentioned. It appeared as if the POC system eliminated paper work in the units where it was used efficiently and reduced the billing time.

An important point that was raised was that the POC relied heavily on its users and as a result, not all the benefits resulting from the POC have been realised. In the audit document it was described that this was mainly due to human errors as the system was not used as intended.

Examples of these human errors were how:

1. Chargesheets were used by the nursing staff away from the bedside. This practice was not acceptable to management and defeated the objective of capturing data at the point of care.
2. Patients were already physically discharged without being discharged on the system.
3. Inventory was barcoded incorrectly

Discontinuation

The POC system was discontinued in October 2004, roughly two years after the implementation was started.

The frustration experienced by the nursing staff and nursing management was summarized in an email by the matron in charge of the POC system, to the hospital manager on Sunday afternoon, 3 September 2004.

In the email the matron mentioned that

- No stock charged since Saturday showed on the system
- It was impossible to do auditing
- The nursing staff was positive up to now but that they (the nurses) and the matron were losing faith. It was said that in 6 months things have not really improved with the POC system and that both the nursing unit managers and the nursing staff are getting increasingly negative.

In conclusion, the implementation of the Point-of-Care information system at the Flora Clinic started off successfully. Over time the system situation deteriorated to the point where the decision was made to discontinue the use of the POC system. An important finding in the last project report was that the POC system was never used as intended and the benefits of the system were therefore never realised. The question that now comes to mind is why did the nurses not use the POC system as was intended by the project and hospital management?

6. PRESENTATION OF RESULTS

This section will present the results of the data extracted from the interviews and other sources of information. (A schedule of the interviews is available in Appendix A.)

The results will be grouped according the framework that was extracted from the literature review.

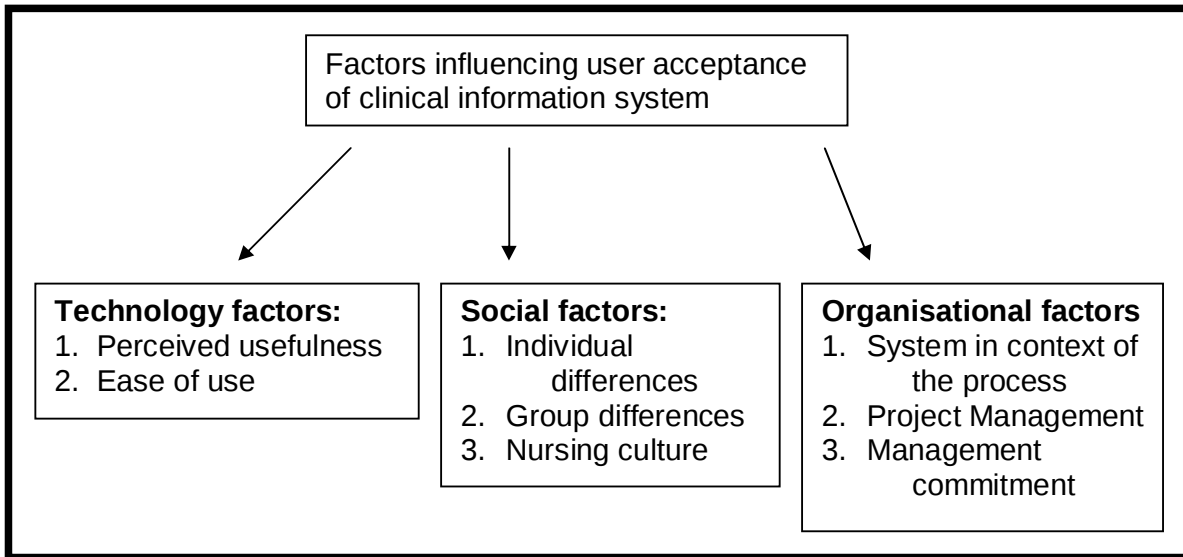


Figure no. 4: Factors influencing user acceptance

6.1. System/Technology factors

6.1.1 Perceived usefulness

Speed and time

The nursing staff's initial interest and excitement, and therefore positive attitude towards the new Point of Care (POC) system, came from the fact that they expected and believed that the POC would improve their work performance.

The general consensus in the general wards and in theatres was that when the POC system worked well and there were no technical problems, the POC helped them to do their work (charge items) faster than the previous paper system. The POC system was

therefore an improvement on the previous paper system and the nurses were satisfied to use the POC system to charge items to patient's accounts.

The improvement that the POC thus provided in terms of the speed with which they did their work also led to a saving in time. According to the staff this extra time could be used to do other tasks and therefore helped to decrease nurse's workload in general.

The improvement in the speed with which they did their work and the time they saved thus created a positive attitude towards with subsequent acceptance of, the POC system.

However, the opposite was also true and when the system was slow and as a result the time it took to charge became longer, the nurses becoming more frustrated.

This frustration led to negative attitudes developing towards the POC system and general reluctance to use the POC system for charging items. Not only did their attitudes change, but in practice nurses also replaced the POC system with a paper system which they considered to be a better alternative. In both the operating theatres and in general wards the paper system was seen as quicker and therefore more useful alternative to the slow POC system.

The replacement of the pen scanning function with the barcode function, improved the general speed (and therefore usefulness) of the POC, but when the system was slow for whatever reason, using both these function was less useful than a paper system.

Not all of the nurses agreed on the speed difference in charging. While some nurses said that the POC was slower than the old paper system, others said that the time spend on charging between the two systems was the same.

However, when the POC system was not working well, none of the staff members interviewed said that it was a better option than the paper system.

After the POC system was removed and a desktop information technology (IT) system was installed in some of the wards, three of the nurses mentioned that they perceive the newer system to be more useful than the POC system due to the fact that it is quicker.

In the end the nurses felt let down by the POC system and one nurse from the general ICU mentioned that just as they got to know the system, the system dropped them.

Increase in workload

Initial excitement in using the POC system also came from the fact that the nurses expected the POC to decrease the amount of paper work they had to deal with every day. Their initial excitement faded when they realised that, due the POC system's unreliability,

they had to do the charging work twice, once on paper and then on the POC itself. The paper system that was used before the POC was installed therefore remained (unofficially) and the task of charging had to be done twice.

Not only did the POC system increase the workload of the nurses in the ward when it was not working optimally, but it also increased the workload of the unit managers (nurses in charge of individual wards). The unit managers were in charge of stock control in their wards and the POC system made stock control more complicated than with the previous paper system. The unit manager from Ward B was of the opinion that of the three systems (paper, POC and computer system that replaced the POC system) she preferred the computer system due to the fact that it provided her with better control over her ward stock. The loss of control the unit managers experience reflected in how, with the POC system, more items were lost than with the previous paper system.

Because item charges done with the POC system were unreliable, the unit managers in some cases had to audit the process to make sure that the item was in fact charged against the patient's name on which it was used. This additional stock auditing process was especially necessary to check on agency staff, night staff and for less experienced ward staff. Not only did it increase the workload of the unit managers but it also took a lot of time to do the process, time that could have been used more productively elsewhere.

6.1.2 Ease of use

Technical reliability and POC system connectivity issues was a very important source of frustration and negativity among system users. The general unreliability of the POC made it difficult for the nurses to use the POC as intended. In the vast majority of the interviews negativity in general came from system connectivity problems. This negativity from the nursing staff was also mentioned by the project manager in a POC system evaluation on March 6, 2004. When the system was down items could not be charged to the relevant patient's account at the point-of-care. This caused

- charges to back up,
- items to be double charged or
- items never to be added to the relevant account.

The POC system started off as being reliable but problems crept in which dramatically reduced user reliability and led to user frustration.

Users experienced both no and slow connectivity and difficult access to patient files. Only the theatre manager felt that the technical problems became less over time. Project management recognized the connectivity problem (server problem in particular) and the possible impact on the viability of the whole POC project going forward and communicated their concerns to hospital management by email.

The system down time also influenced stock control negatively through stock getting lost and an increase in the work that had to be done. In both the wards and theatres parallel paper system had to be implemented to cope with the connectivity problems. (See System in context of the process)

Other important infrastructure problems that impacted negatively on the use of the POC system were

- problems with the barcodes. The wrong barcodes or no bar codes were put on the stock in pharmacy which made it impossible to either charge the item or charge it correctly.
- In theatre the patient's name was sometimes not on the files with no code available for booking the patient into the theatre complex.
- In order to discharge patients, files had to be out of the ward in 6 hours. The POC system did not allow for this.

The handheld device was easy to use when charging items but, in the theatre complex staff felt that if they were under time pressure it became more difficult to use.

Some of the staff experienced that due to the fact that there were only 4 handheld devices in a specific ward it was difficult to utilize the POC system at the bedside as intended. (accessibility problem) The ward unit manager of ward C disagreed and felt that 4 handheld devices in one ward was enough.

One of the factors that made the POC difficult to use was that once information was entered on to the system, it could not be easily removed by the user. This was a problem both in the general wards and in theatre (theatre manager)

Other factors that made the system difficult to use were that

- The pen system used initially for charging was impractical.
 - Over time wear and tear made the system more difficult to use.
 - Two or more staff members could not load information into the system at the same time.
- This was especially a problem in the theatre complex where if the anesthetic nurse and

the surgical nurse both wanted to load information, they could not use the system at the same time.

- In theatres information was sometimes lost after it was loaded onto the system due to what the nurse called a 'reset' function. This happened automatically and without a prompt by the user.
- Information put into the system in a theatre got 'lost' between the hardware on theatre and the printer.
- The system did not want to save information that has already been scanned into it.
- Sometimes items were scanned in but could not be viewed on the system.
- The system did not accept the staff access.
- Charging with the pen function did not work well.
- Sometimes the scanned item would show on the system in the ward but not on the system downstairs.

6.2. Social Factors

6.2.1 Group differences

Ward environment

The general spirit in a ward also appeared to influence the whole ward's acceptance of the POC system, like for example in the medical ICU. In the MICU the majority of the staff in were very positive and excited about the POC and welcomed its implementation. According to an outside nurse from GTICU, the MICU had a positive working environment which in her opinion was a better environment than in other wards. In her opinion the feeling of being a team in MICU (good team spirit) made a great difference in the nurse's attitude to using the POC. She explained how in MICU there was a better 'vibe' than she experience in GTICU.

Another example of a ward were the general positive feeling in the ward appeared to influenced the acceptance of the POC system was in the psychiatric ward, Ward H. In this ward in general they were very positive towards the POC and and were very open towards technology and as a result it was accepted well.

Other factors also influenced the use of the POC in Ward H. These factors were the following:

- The staff was forced to use the POC often due to the lack of a ward secretary.
- The positive attitude and leadership of the ward manager
- The fact that the workload and pace of work in a psychiatric ward tend to be less than in the more acute surgical and medical wards.

An example of an area where negative sentiment in general influenced POC acceptance was in the theatre complex. Due to the fact that the POC system in the theatre complex was only implemented after the POC systems in the ward, negative sentiment that developed in the wards carried over to theatre complex. One of the nurses in the theatre complex mentioned that this negative influence from the general wards definitely influenced the attitude of theatre staff towards the new POC system.

Types of wards / nurses in ward

In a ward to ward breakdown it was described how general ward implementations were more successful than the ICU implementations with the exception of MICU. (The first project report; 13 November 2002)

Nursing staff from both the GTICU and the MICU felt that the high tech environment in ICU made ICU nurses more open for POC acceptance.

The unit manager of one of the ICUs also mentioned that that ICU nurses have different personality types than the nurses in the wards, and that they probably needed different types of training.

ICU nurses also function more as individuals in their work environment. As a result they, with regards to the POC system, taught and helped each other less. This is in contrast to the general wards (Ward A & Ward B) where nurses often helped each other solve POC related problems. The Ward A unit manager felt that in the general wards wrong POC practice might have been transferred through peer support and that in especially Ward B, nurses negatively influenced each other towards POC system use.

Although individualistic nursing behaviour appeared to apply during a normal workload, in both MICU and oncology (where nurses also nursed one-on-one) nurses helped each other charge during busy periods.

In Ward J nurses also first asked each other before they called tech support out to help. Nursing level also played a role and it appeared as if the nurses with the most responsibility (senior nurses) stayed positive towards the POC system for longer.

6.2.2 Individual differences

Attitude

Individual attitude also appeared to influence the degree of POC system acceptance.

The unit manager in Ward H (psychiatric ward) was an example of a very positive individual. His attitude towards the POC started out as positive and he stayed positive till the end. He also strongly felt that an individual's general attitude made a huge difference in how they used the POC. In his opinion attitude towards the POC could make all the difference to its acceptance. Another nurse in the same ward also had a very positive attitude and also stayed positive towards the POC system till the end. The opposite was also true and the ward clerk in one of the wards explained how she witnessed negativity from the nurses towards the POC and how this was specifically in nurses that had a negative personality.

There appeared to be a strong correlation between a general positive or negative personality type and being pro- or anti-change. The theatre manager explained how in her experience there will always be people that resist change and others that accept it. She provided one of the nurses in theatre as a very good example of a positive person that would accept any kind of change. In a interview with this specific nurse no significant negativity towards the POC system came from the interview in contrast with some of the other theatre interviewees. This nurse was very positive in her outlook on life and she accepted the change (POC implementation) brought about in her environment (theatre complex) readily.

A caregiver (junior nurse) in one of the wards (oncology) observed that a lot of the negativity towards the POC system came from people who were resistant to change in general.

Computer skill / literacy

The general feeling amongst the interviewees was that computer literacy and previous exposure to computer use did increase the acceptance of the POC system. Staff in the theatre complex that were less skilled with computers, were reluctant to use the POC and in GTICU the unit manager felt that her computer literacy definitely helped her to accept the POC better.

The young caregiver nurse in the oncology ward said that her computer literacy was the biggest factor that helped her to accept the POC better and the young computer literate ward clerk in Ward C saw POC as progress and was positive towards it. For both these two

younger interviewees age probably also played an important role in their acceptance of the POC system.

In one of the general wards a computer literate nurse observed that the more computer literate nurses, accepted the POC better. She also emphasized the fact that for her previous exposure to computers was a very important factor stimulating her POC system use.

A unit manager that saw herself as computer literate was of the opinion that computer literacy did not really make a difference to the POC being accepted in her ward. Another older unit manager was positive towards the POC although she was not very computer literate and in her case organizational position might have had an influence.

Age

The general consensus was that the older nursing staff were more reluctant to use the POC system over the paper system. In MICU the unit manager described how she had to do a lot of canvassing to get the older staff on board.

Once again the older and computer illiterate unit manager of the pediatric ward was the exception to the rule and accepted the POC from the start. But, as mentioned above (under Computer skills/literacy section) her position as unit manager might have played a role in her acceptance of the system. What was interesting was that she also did not have any problems with the older staff in her ward accepting the POC. In the interview with one of the older nurses in the ward, the nurse felt that her advanced age did make her more reluctant to use the POC.

For a nurse in Ward B (a general ward) age did not play that big a role, as long as the person had computer experience.

As mentioned above in the 'Computer skills/literacy' section, the two younger staff members (caregiver and ward secretary) accepted and used the POC well and in both their cases it might have been a combination of their computer literacy and their age.

Other factors

In the theatre complex and in Ward A some of the staff struggled with their retention of the POC information and it was mentioned that the mental capacity of individuals also played a role in how they accepted and used the POC system.

Based on this it was recommended that training needed to be individualized in order to fit different individual's needs. (This was not specifically age related)

One nurse in theatre felt that the POC stimulated her to grow as a person and she already planned to attend a computer course and learn more about computers during her next holiday. This nurse clearly had an appetite to develop herself further.

Another important factor that emerged from the data gathering was how staff members in management positions (unit managers) felt a responsibility to stay positive and motivate their staff. A good example of this was with the unit manager of Ward J (pediatric ward) as mentioned above that, despite her advanced age and computer illiteracy started out and remained positive. The unit manager in Ward C is another example of a person who started out as positive and clearly communicated that through to her staff. Even when she became frustrated with the POC and her attitude changed, she still told the staff that they all should stay positive. She definitively felt that she had a responsibility as senior person to stay positive and motivate her staff.

Organisational position and therefore responsibility might also have played a role in how change was accepted and two of the nurses in leadership roles described how they themselves were not resistant to change and as a result they accepted the new POC system well in the beginning.

6.2.3 Nursing Culture factors

Caring culture

The caring culture of nurses towards their patients played a very important role in how the POC system was used in the wards. As mentioned before, the POC system was supposed to be used for charging items (capturing data) at the patient's bedside. In the majority of the wards (MICU, oncology, Ward A, Ward B, Ward J and in operating theatres) nurses felt that the POC negatively influenced the way and the quality of the care they provided to their patients. Because patient care is so important to nurses, they refused to use the POC at the bedside. In other words, they were not prepared to compromise on patient care and did not allow the POC system to influence the quality and type of care they provided to their patients.

In GTICU one of the nurses felt that the patients did not necessarily benefited from the POC system and that the quality of service provided to them did not change. In MICU the nurses did not let POC interfere with the level of care and felt that in ICU time spend with

patients was even more important than in the wards. The ward clerk in MICU described how, if the nurses had problems with the POC, they passed it on to her in order to attend to their patients.

In the oncology ward and also in Ward B and Ward C, the same happened where more senior nurses passed the charging duty (use of POC) on to the junior nurses if they felt that they had to attend to their patients. This had a negative effect in that the nurses with the highest workload (usually the most senior nurses) became negative first.

In oncology it also appeared as if the more senior nurses did not want to ask the junior nurses that knew how to work with the POC, for help in using it.

A combination of the above mentioned, ward hierarchy and the fact that they had too much clinical work to do, made it easy for these senior nurses to delegate the work down to the caregivers and get on with their clinical work. The fact that the caregivers were their juniors, had a big appetite for learning and were also more computer literate made it easy for the more senior nurses to care for the patients and to let the caregivers do all the charging. In the oncology ward the computer literate caregiver was happy after the POC was removed because she felt that she was abused by other nurses in doing their charge work for them.

The unit manager from Ward A also felt that charging was not the work of a nurse. In this ward in the beginning, nurses spent a lot of time with the POC and the patients complained about it. It appeared as if the POC system made nurses look like bad carers in the eyes of the patients and that this was not acceptable to nurses.

Once again Ward H bucked the trend. In this ward the perception was that, the quality of the care improved due to the fact that the POC saved them time and they had more time to spend with the patients.

Time and workload

The workload in the wards also influenced the way in which the POC system was used. According to the unit manager in oncology ward nurses in general are busy and do their work at a quick pace. One MICU nurse felt that it might have been more difficult in the general wards to use the POC because they were busier and that in ICU they had more time available than in the wards. That appeared to be the case and both Ward A & Ward B (general wards) turned out to be very busy wards where the workload in the wards caused the staff to change the way in which the POC was used. (They could not charge at the bed) In these wards they were very busy and had little time to do charge work.

In the theater complex two of the nurses were negative in the beginning because they thought the POC would take up their time and in Ward J (pediatric ward) one nurse also felt that the POC stole time from the patient.

The unit manager in the less busy psychiatry ward (Ward H), also said that because they (staff in Ward H) were not as busy as the staff in Ward A, they accepted the POC system better.

The pressure generated by the use of the POC system also caused other problems:

1. In MICU the staff agreed that due to the POC the ward clerk was put under pressure.
2. In theatres the stock capturer got the idea that the nurses did not capture accurately due to too much time pressure.

As in most other instances individual attitudes once again played a role and a very positive nurse in MICU felt that the POC did not steal time from the patient, but that on the contrary it gave the nurse more time at the patient's bedside. However, this nurse was also negative in the beginning because she thought that the POC was going to waste her time but changed her opinion when she saw how easy and helpful the POC was going to be.

Professional appearance

POC use also had an influence on nurse's professional appearance. For one nurse the mention of POC system use impressed nurses from other hospitals during conversation but others resented the fact that the POC made them appear unprofessional. (The unit manager from GTICU said that connectivity problems made her look bad on the end of the month reports.)

In Ward A and especially in theatres, doctors complained about the fact that the nurses spent too much time on the POC and not with the patients. (Nurses treated the technology and not the patient.) This resulted in a lot of stress being put on the nurses.

Other cultural factors

A unit manager that had nurses from both South Africa and the UK in her ward mentioned that she experienced different working cultures in nurses from these two countries. Even between South African nurses from different cultural backgrounds, POC system acceptance and use appeared to differ.

6.3. Organisational factors

6.3.1 *System in context of process*

Some of the nursing staff interviewed was of the opinion that the POC system did not fit well into the general ward environment and was too slow for the clinical processes in the ward.

An example of how the POC system interfered with the smooth running of ward processes, was how it

- slowed down the transfer of patients between wards and
- prevented patients from being discharged if stock was not charged to their account.

It therefore influenced the flow of patient between wards and on discharge with the possibility of blocking beds and unnecessarily keeping patients in the hospital longer.

Due to the fact that the nurses were not willing to impair the quality of care they provided to their patients, they changed the way in which the POC system was used.

In order for the POC system to fit into the ward nurses either

- adapted the way in which the POC was intended to be used
- introduced alternatives to the system.

Adaptations to the use of the POC

The mismatch between the POC system and the nursing processes led to adaptations in how the POC system was used in the ward.

The following examples were given of things they had to do differently because they could not use the POC system at the point of care:

- In the beginning they tried to remember what items they used on patients at their bedside, to be charged later at the nursing station.
- They kept wrappings of the items that they used and then charged them later. They even had a bag in which they kept the wrappings when they became too many.
- In Ward C the nurses tried to do some of the charge work before they did the clinical procedure but this also did not work.

Adaptations to the way the POC system was used was commonplace and even in the psychiatric ward where the POC system worked very well, adaptations were made to the POC to fit in with the processes in the ward.

These changes differed from ward to ward and the reasons provided as to why these changes were made also differed.

According to the nurses interviewed the *intensity of nursing work varied on a daily and weekly basis* and most days and weeks have time periods that were busier than other. This cyclical nature of the nursing processes caused a bottleneck effect and the staff experienced problems especially during

- during the evening and night shift in both the wards and theatres and
- on weekends, when there was lot of problems.

The *intensity of the workload in different types of wards* also differs and according to one of the unit managers the POC did not work well in the busier surgical wards. In these wards the nurses changed the intended use of the POC by first doing their work with the patients before they did the charging.

In the oncology ward also the staff were too busy to use POC at the bed side, but agreed that if the ward was less busy it would have been possible to use the POC system as intended by the bed side.

The *workload of individuals* also differed and some of the more senior nurses had more work to do than the junior nurses. In two of the wards (a general ward and an ICU) the POC increased the work load of the caregivers (junior nurses) and ward secretary respectively due to the fact that they had to do the backed up charging. An example of this is how in one of the general wards, the caregivers did a lot of the charging due to the fact that the senior nurses had to do ward rounds with the doctors. When the system was down, charge work was passed on to the ward clerk in two wards who then had to charge items to the relevant accounts on behalf of the nursing staff. By doing this the nurses adapted the way the system was supposed to be used to fit in with the processes in the ward.

It is possible that the *nursing processes of different levels of nurses* could have influenced their view of the adaptability of the POC to the nursing process. The oncology ward unit manager felt that if the POC was used as intended it would have negatively influenced the patient care in the ward.

One of the caregivers in the oncology ward used the POC system as intended next to the patient's bed, just after she used an item. In this junior nurse's opinion the workload and responsibility she had on her nursing level allowed her to use it in this manner.

In the operating theatre complex there was a *small margin for error* due to the nature of the work and as a result the staff was very dependent on the POC system. One interviewee experienced the POC system as too slow for the processes in theatre and another said that if the POC system went down, it severely disrupted the workflow.

The complex manager in theatre felt strongly that the POC had to fit in with the theatre processes and not the other way around. This was however not the case and the following were two of the problems encountered by staff in theatres:

- The “clocking in” and “clocking out” of patients into individual theatres proved to be problematic. With especially shorter lists they could not use the POC for the “clocking in-and-out” process due to the fact that there was no time. Especially the nurse helping the anaesthetist (anaesthetic nurse) encountered this problem.
- Another problem encountered in the theatre complex was that the POC was never used in Theatre G due to a layout problem. Medical equipment used during surgery was in the way of the POC and the POC was subsequently never used.

An example of how the POC worked well when adapted to a theatre process was with the incorporation of preference lists into the POC system. Interviewees described preference lists as a list with a certain doctor's preferences in terms of drugs and equipment all on one list. These lists improved the flow of work in individual theatres. A couple of nurses described how these preference lists worked well in Theatre E, but was never incorporated into any of the other theatres for reasons unknown.

Alternative systems

In many wards paper systems were introduced (Ward B, Ward C, MICU and Oncology ward). In some of the wards the paper system ran parallel to the POC system (Oncology ward) and in other wards the system was only introduced when they could not use the POC system. (Ward B, Ward C, MICU)

The following are some of the reasons provided by the nurses for the introduction of paper systems:

1. In Oncology ward a paper system was automatically put in place to address the POC system's shortcomings and to use when the system was off. The unit manager in this ward realized that the negativity in the ward would cause the nurses not to charge accurately and she pre-empted problems by introducing a paper system. In other words,

- the unit manager allowed for two parallel systems to be used in order to make sure that the ward ran smooth and effectively, even if it increased the workload.
2. In Ward C the opinion was that the POC system was unreliable and a paper system was introduced. When it was busy charges were first written in a book and were charged afterwards. A nurse with time on her hands would then take the backlogged charges written up in the paper system and transfer them to the POC system.
 3. In the operating theatre complex, Ward B and MICU, the staff immediately started using a paper system the moment the POC system went down, in order to enable them to do their daily work.
 4. For stock control purposes, a paper system was put in place running in parallel with the POC system in two of the general wards and in one of the ICUs. Interviewees from each ward described how having only the POC in place was not adequate for controlling stock and that a paper system also had to be put in place. One of the unit manager's nurses experienced an increase in the workload in her ward and that work had to be done twice for optimal stock control. For another unit manager the audit function in the ward became more important because item charging became less accurate. In total, interviewees from five different wards experienced stock control problems due to the influence of the POC system on the stock control process.

In all of the cases the initiative of the paper system came from the staff in the ward and was in response the POC system not providing them with the necessary support to run the ward in an optimal manner.

6.3.2 Project management

Change

From the nursing staff (end users) there were also indications that resistance to change influenced their intention to use the POC system.

An example of how resistance to change influenced POC system acceptance negatively came from one of the ICU wards. During the implementation of the POC system in this ward unit manager 1 (UM1) was unit manager. UM1 left the hospital after problems with management and a new unit manager (UM2) was appointed in her place.

When UM2 took charge of the ICU she experienced a lot of resistance to the POC system from the staff. As a group they even wrote her a letter discussing the problems they experienced with the POC system. According to UM2 the resistance to change she

experienced had its origin in the fact that the hospital has changed owners so many times in the last few years. It also later came from an interview that UM1 was very anti-change and this might have cascaded down to her staff.

In the interview with the POC system project manager it also emerged that she experienced a lot of resistance from UM1 and the staff towards the implementation of the POC into the ICU. The project manager was also of the opinion that UM1 negatively influenced the attitude of the staff in the ward towards the POC system.

One of the staff members also mentioned that the staff in the ICU was very sensitive towards change due to all the owner changes that took place over the last couple of years. In this ward it appeared as if the combination of an anti-change unit manager and sensitivity towards change of ownership had a negative influence on the way in which the POC system was used in that specific ICU.

Communication

The nursing staff were of the opinion that pre-implementation preparation of the staff members through internal marketing and presentations, helped to create a positive attitude towards what was then the new POC system.

This was especially true in the theatre complex where a lot of negativity was brought in from the wards where the POC system was already implemented. The presentation that was given before theatre implementation did a lot to squash this initial negativity. Communication continued after the implementation between project management and nursing management via emails in order to try and identify problems experienced by users. The users (staff in the wards and theatres) did not experience communication from management to be very effective and this inadequate communication caused frustration amongst the nursing staff. Examples of inadequate communication provided by the nurses were the following:

- The unit manager in one of the ICUs said that her ward were just accused of negativity but nobody ever asked why they were negative.
- When there were problems with the server, the nurses were not updated and became frustrated because the POC system was not working.
- In one of the ICUs that was without a unit manager for 9 months (lack of leadership) one of the staff members that had to do the majority of the charging in the ward complained that there was no manner in which she could communicate the problems she experienced through to management.

- The hospital manager stated that he never received the message that there were problems with the POC system. He only got the complaints about the POC system at a special meeting between management and the staff representatives.

User communication with technical support also proved to be ineffective and some nurses said that the staff from the technical support team did not believe them when they reported the problems they experienced with the POC.

Another problem mentioned by one of the unit managers was that certain expectations were created when the POC system was marketed to the staff but that the system never lived up to those expectations.

The letter from the staff written to the second unit manager of the ICU mentioned above, was probably also an indication that the staff in the ward struggled to communicate their grievance through to management.

In the end it appeared as if good communication before the implementation created a positive attitude with the staff, but that more effective communication could have played a major role in solving those problems that proved to be barriers in the effective use of the POC system.

Decision involvement

Two of the ward unit managers and the theatre manager were very clear that if nurses were involved in the decision making about the POC before it was implemented, a lot of problems could have been eliminated.

The theatre manager gave an example of this by explaining how the paper charge sheets concept that was used in theatres before the POC was installed worked very well and how it could have been built into the POC system before it was implemented. She however never had the opportunity to give input and it was never incorporated. Some improvements were however made to the POC system after the implementation in response to feedback received from the nurses and these changes made a big difference to the value added by the POC.

Technical support

In the general wards (Ward A, Ward B, Ward C and the paediatric ward, Ward J) and ICU's (MICU & GTICU) the consensus was that the technical support for the POC system was insufficient and inadequate. This view was especially shared by the unit managers in these

different wards. (Here it is interesting to note that two junior ward nurses from different wards said that they experienced the technical support to be adequate and available. This once again indicate that the requirements from the POC system differed on different nursing levels in the wards.) A few of the interviewees mentioned that just after the POC was implemented the technical support was adequate but that it deteriorated over time. Some of the nursing staff had strong opinions on the quality of the technical support. It was mentioned that the support team was never available, how the quality of the back-up was bad and how the technicians were incompetent.

UM2 in the ICU discussed above, reported how the inadequate technical support levels were also mentioned to her in the letter she received from the staff when she took up her unit manager position in the ICU.

In the Oncology Ward the feeling was that the technical support was adequate and once again this indicated that not only were the requirements different between nursing levels, but that the requirements from ward to ward also differed.

In the theatre complex the full time technical support made a huge positive difference in the functioning of the POC system just after it was implemented. When this full time support was stopped, a lot of the problems started which led to negativity with the users. Interviewees were of the opinion that technical support in operating theatres 24 hours of the day and 7 days of the week in theatres was an absolute necessity. It also appear that the very intense support that Theatre E had in the beginning as the pilot theatre made a very big difference in the attitude of the nurses in these theatres towards the use of the POC system. One of the interviewees in theatres said that she felt that the technical support team needed better training.

As mentioned above, it appears as if the more senior staff (unit managers) experienced the technical support as inadequate. The fact that they as individuals had the most responsibility in the ward and had to answer for the POC use definitely had an influence on their perceptions.

Training

In the ICU setting the training provided to the nursing staff was not sufficient and the unit manager of the ICU had to spend extra one-on-one time with especially the older nurses to help them with the POC. The stock controller in this ward said that some of the nurses

came to her for assistance due to the fact that they did not know how the POC worked. In the same ICU only one nurse felt that training was sufficient.

In the Oncology Ward and in the pediatric ward, Ward J it was felt that the training received was sufficient.

In the general wards also (Ward B and Ward C) the feeling was that training was sufficient but very basic. They were only taught to use the basic functions but were not taught how to solve simple problems and in the end they ended up struggling with the use of the POC system.

In the operating theatres complex, the manager and one of the nursing staff described how the training made a big difference in nurse's acceptance of the system. The manager was also of the opinion that the training was not sufficient for all types of individuals and that the amount of training had to be individualized for certain individuals. One of the theatre nurses shared her view that training was not sufficient for everyone. Another interviewee agreed that the training in the beginning helped a bit but said that she learned more from using the POC in real life situation. This raises the question that there might have been a need for not only ongoing theoretical training but also for training in real life settings.

The stock controller in operating theatres was of the opinion that the nurses needed better training in order to help them to capture the items used more accurate. This would have made her work easier to do.

The opinions on the adequacy and influence of training differed from ward to ward. The two important points that came to the fore were that

- training made a big difference in how nurses accepted the POC system
- different types of users needed different amounts and types of training

6.3.3 Management commitment

Middle management

Nursing leadership also played an important part in influencing attitudes towards the POC system. An example of this is how, according to a third party, the unit manager in one of the general wards did a lot to promote the new POC system to the staff in the ward. In the

beginning this helped a great deal in making them more positive towards the system but towards the end even the influence of the unit manager could not prevent the staff from becoming negative towards the system due to connectivity problems.

The unit manager in the psychiatric ward, Ward H, also was of the opinion that nursing leadership played a big part in how the staff felt and how they used the POC system. In this ward the POC system was well accepted and used and he gave examples of how, when the unit manager was positive, the staff was more positive and also how staff would observe how he used the system. The unit manager in Ward H also advised that it was important that the nurse leader actively promote the system to the staff.

In his view the unit managers' roles did not stop at promoting the POC system but they should also make sure that the necessary training and support were provided to the staff in their wards. He gave an example of how he prepared his ward staff for the system before its implementation and is sure that it made a difference.

For the unit manager of the oncology ward it was difficult to promote a system to her staff that she knew was not going to work. She was also put under pressure by management to force her staff use the system. She was told by management to force the staff to use the system, but could not do it and this got herself into trouble. She could therefore in other words, not promote a system to her staff that she did not believe in herself.

The unit manager of one of the ICU's had a huge problem with stock control on the POC system, but was prohibited from implementing a lateral paper system to address the problem. It surfaced during the interview that this made her negative towards using the POC system.

The unit manager of the pediatric ward, Ward J, made the POC system a team initiative and used the younger staff to support the older staff in using the POC.

For one of the nurses in theatres, the support of the theatre manager and other managers made a difference in how she accepted the POC.

Top management

In terms of commitment from top management, one of the interviewees experienced good buy-in from the hospital management into the POC system but one of the unit managers was of the opinion that management could have been more visible. Another unit manager mentioned how she felt that hospital management in general paid more interest to the financial side of the hospital and did not give the nursing aspect the necessary attention.

Some of the nurses felt that they did not experience all the functions that were sold to them with the initial marketing of the POC.

The following comments were also made about management.

- Management's expectations regarding the POC system were too high
- The POC system was forced on them by management.
- Management did not understand the nursing processes well enough

The above-mentioned opinions demonstrate that there was room for improvement through more management involvement and better communication between the nurses and top management.

Part time staff

Part time nursing staff are commonly used in hospitals and they also unintentionally compounded the problems that led to user negativity.

Because these part time staff members only worked at the hospital for short periods, they:

1. Were not very keen on using the system due to, amongst other things, a lack of training.
2. Did not know how to use the POC system
3. Damaged the system.
4. Did not have access cards to use the system.

Although one nurse was of the opinion that the part time nurses could be shown how to use the POC and some of them did charge by the bedside, it was for the majority of the time just easier for the permanent staff members to use the POC system on behalf of the part time staff. This meant that the permanent staff physically had to charge items used by the part time staff to the relevant patient accounts. If taken into account that some nurses also had to charge for some of the caregivers and physiotherapists, it is clear that in this regard the POC increased the workload of permanent staff.

In a project team meeting held on 15 November 2005 it was recognised that one of the main challenges in the wards remained the charging by agency staff.

7. DISCUSSION OF ANALYSIS

The purpose of this research is to discover why end users accepted or rejected a clinical information system

7.1 Discussion based on research proposition 1

The acceptance of clinical information systems by end users is influenced by one or more of the following factors:

- Technology factors
 - Perceived usefulness
 - Perceived ease of use
- Social factors
 - Individual differences
 - Group differences
 - Nursing culture
- Organisational factors
 - The fit between the system and work processes
 - Project management factors
 - Management commitment

In order to answer the first sub-problem of what factors affected the acceptance of the CIS by end users, the framework as stipulated in the 1st research proposition will be used.

7.1.1 Technology factors

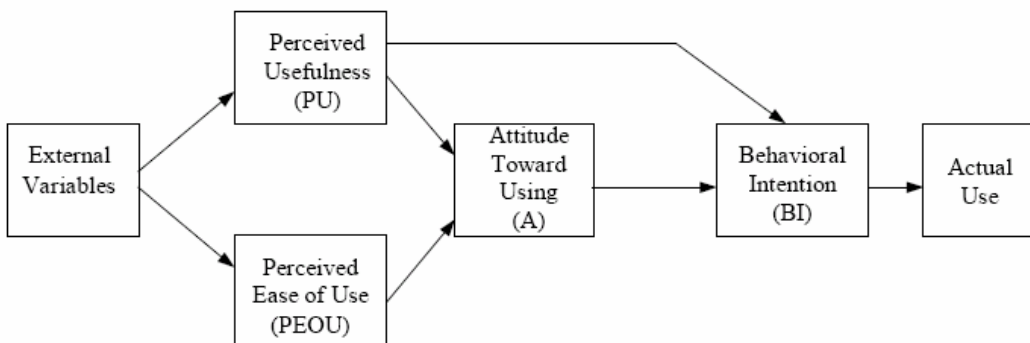


Figure 5: The Technology Acceptance Model

Perceived usefulness

“Perceived usefulness captures the extent to which a potential adopter views the innovation as offering value over alternative ways of performing the same task.”

(Agarwal & Prasad, 1998:18)

When the end users of the POC system at the Flora Clinic perceived the system to improve the speed at which they could complete tasks, saving them time in the process and decrease their workload, they had a very positive attitude towards the POC system and used it as intended. What was also clear was that when they perceived the system to be less useful by slowing them down, taking time and increasing their workload, their attitudes changed rapidly and they were reluctant to use the system. The POC was then replaced with what they perceived as a more useful, parallel, paper system.

Ease of use

“(Perceived) Ease of use encapsulates the degree to which a potential adopter views usage of the target technology to be relatively free of effort (Davis et al., 1989).” (Agarwal & Prasad, 1998:18)

The connectivity problems experienced between the handheld devices in the ward and the server in Bedfordview made the POC system difficult to use as intended (at the point-of-care). Nurses would charge an item used and due to a faulty connection between the device and the server, the item will not be charged to the relevant patient's account. Due to the fact that they perceived the POC system as being difficult to use to do their work with, the majority of the nursing staff became negative towards the system and were reluctant to use it at the patient's bedside. Most of them opted for the easier to use paper system (wrote a list of items charged) and when they knew that the POC system was up and running, they charged all the items on the list to the patient's account.

These research findings regarding how perceived usefulness and ease of use influenced attitude towards technology, intention to use the technology and actual use, endorsed the Technology Acceptance Model's ability to explain variance in potential adopter's attitude towards using technology. (Agarwal & Prasad, 1998)

When the end users (nursing staff) perceived the technology (POC system) to be useful and easy to use in completing their tasks, they used the system.

But , the opposite was also true that when they perceived the system to be less useful than the paper system and difficult to use, they opted not to use it as intended.

7.1.2 Social Factors

Individual differences

Individual differences amongst end users of the POC system extracted from the data were individual attitudes / personality, familiarity with technology in general, age, learning capacity, organizational position and individual need for development.

The influence of these individual differences on the acceptance of the POC system at the Flora Clinic will be discussed in more detail when addressing the second research question below.

Difference between user groups

The ward environment, type of ward and the type of nurse in the ward, all played a role in how the users (nurses in the ward) differed in their acceptance of the POC information system.

The influence of these factors, as with individual differences, on the acceptance of the POC system will be discussed in more detail when addressing the second research question below.

Nursing culture

The caring culture as described in the literature review by Simpson(1996) and Wilson (2002), nursing time constraints, workload and professional appearance of the nursing staff, are all factors specific to nursing as an occupation, that influenced the acceptance of the POC system at the Flora Clinic.

In this case study nurses had a very low tolerance towards the negative impact that the POC system had on the *care they provided to their patients*, as was the case in the example provided by Wilson (2002) where a system was rejected because it took nurses away from hands-on patient care. In the majority of the wards at the Flora Clinic where the POC system was available, nurses did not allow the POC to interfere with their caring duties at the bedside. As soon as they felt that charging items at the bedside impacted negatively on patient care, they immediately stopped using the POC at the point-of-care. They did not however refuse to use the POC system for charging but rather changed the way in which it was supposed to be use (at the bedside) to using it for example at the

nursing station. To the nurses this was a non-negotiable matter. It is important to note that there is a strong likelihood that if point-of-care technology is to be accepted and used by nurses, it should have no negative impact on the quality of care that is provided to patients. The general *high workload and time constraints* experienced by nurses in this case study also left small margin for error to the POC system. If nurses had too much work or too little time and the system did not fit in for whatever reason, they rejected the use of the POC system at the bedside till the situation improved. The behaviour demonstrated by the nurses was the same as mentioned by Wilson (2002) where, when under time or work pressure, nurses chose providing care and used (paper) systems that they trusted. It was also clear that in wards that had more long term patients and therefore less patient turnover (for example in Ward H, the psychiatric ward) that the POC system was accepted better and was used as intended.

Like everyone else, nurses also want to *appear competent in their job*. In the interviews it surfaced that not only did the POC system negatively influence nurse's appearance in front of the patients that they treated, but doctors also complained that nurses were "treating the technology and not the patient." This put nurses under unnecessary stress and broke down professional relationships.

7.1.3 Organisational factors

System in context of the process

The way in which nurses adapted the intended use of the POC system or replaced the system was an indication of how they would rather make changes to the system than to the existing processes. Through these adaptations and replacements they actively rejected the intended use of the POC system because it did not fit into their nursing processes and it therefore might have reduced care provided to patients. The poor system integration into nursing processes was therefore counter-productive in information collection and increased the workload in the ward as described by Kuhn & Guise (2001), Sensky (2002) and Doyle (2002).

The proposed adaptations needed on both the system and the work processes in order to fit into each other (Kuhn & Guise, 2001) happened only on the POC system. An example of an adaptation made to the system was in the theatre complex where doctor preference lists were introduced onto the system in one of the theatres, which led to better work process integration in that theatre. In all the data gathered no mention was ever made about changing the work processes to create better fit with the system. It can therefore be

expected that when both the system and work processes are adapted to fit the other, a near perfect fit with the resulting benefits could be achieved.

The ability of information technology to integrate into healthcare processes is therefore another very important objective because it is clear that without integration, information technology will only complicate and strain work processes in the hospital setting further.

Project Management

For some of the individuals interviewed and for one ward in particular, individual and collective *resistance to change* negatively influenced acceptance and use of the POC system. As mentioned in an earlier section, negative personality type individuals were cited as the most likely to resist change and might also have played a major role in the ward where change was resisted by the majority of the staff. In the ward referred to, the POC system (as a change process in the ward) was actively resisted by the first unit manager and her resistance also negatively influenced the nurses in the ward. Not only was the POC system therefore not well accepted in that ward, but even after the first unit manager left, the general resistance to the POC system lingered in the ward. With this example, the Flora Clinic joins the list of organizations where resistance to change emerged as a key factor to which information system implementation difficulties could be attributed as mentioned by Jiang et al. (2000).

It also emerged from this case study that sensitivity to change due to a lot of recent changes might also play a role in lowering the tolerance level towards change.

The importance of good *communication*, as described by Page (2000), Lorenzi and Riley (2000), was also supported by the findings in this case study. Pre-implementation communication to the staff helped to create a positive attitude in the beginning but the inadequate communication between the nursing staff and different management levels did cause frustration with the nurses and better communication could have solved problems quicker and more effectively. A communication platform as described by Korth (1993) where ward level nursing staff have representation on units that made decisions that would impact on nursing care, could have made a big difference at the Flora Clinic Hospital in identifying problems and solving them before they influenced POC system acceptance and use negatively.

Nurses were not as involved as they would have liked to be in initial decisions made regarding the POC system. *Decision involvement* goes hand in hand with good communication and would have prevented problems and facilitated the buy-in that was necessary from the nurses.

Sufficient and insufficient *technical support* to the users indirectly influenced end user acceptance of the POC system. Sufficient support made the system easier to use (no connectivity problems) and this improved the attitudes of nurses towards the system. The lack of sufficient technical support negatively impacted on end user attitude and system usage. The difference between good initial technical support which led to system acceptance in theatre and negativity towards the system when the support was less than adequate, is a excellent example of the impact that good support can have on user acceptance of the system. One also got the idea from the interviewees that the level of technical support they experienced was an indication of the level of project management support towards the POC implementation through visibility.

The findings with regards to the adequacy of *training* were very mixed and the only clear-cut message was that on both an individual and ward level training experiences differed. As mentioned in the results discussion, the two important points that came to the fore were that

- training made a big difference in how nurses accepted the POC system
- different types of users needed different amounts and types of training

Management commitment

Visible, positive attitudes from unit managers were an important determinant of the attitudes of the staff in that ward towards the POC. Once again the opposite was also true in that in the problematic ICU the negative attitude of the first unit manager and her resistance to change did, what appeared to be, irreparable damage to the team spirit and attitude towards the POC in that ward. The positive role of *nurse leadership* as described by Page therefore appears to be a strong factor that ensures a positive user attitude towards technology.

The message regarding the influence of *top management* on POC system acceptance was not consistent and the only conclusion is that there was room for more communication between top management and the nurses.

Part time Staff

The problem experienced with part time staff was that because of their non-permanent nature, they lacked POC system training and access. Their inability to use the POC system increased the workload of the permanent staff in the ward and therefore had a negative influence on nursing staff attitude towards the POC system.

7.2 Discussion based on research proposition 2

Individual end users of a clinical information system differ in their acceptance of clinical information systems based on

- individual differences
- differences in work environments

7.2.1 Individual differences

As mentioned above, the individual differences amongst users of the POC system that was extracted from the data were individual attitudes / personality, computer skills, age, learning capacity, organizational position and individual need for development.

Positive *personality types* with positive *general attitudes* appeared to have accepted the new POC system at the Flora Clinic from the start and stayed positive till the end. The opposite was also true and external observations were made that negative personality types had a negative attitude towards the technology. There is also a correlation between negative personalities/attitudes and resistance to change and this could help project management teams to identify individuals prior to implementations that might actively resist the change brought about by new technology implementation.

The observations/statements made by Agarwal & Prasad (1999) that *individuals familiar with technology* are more likely to have positive beliefs about new technology proved true in that the general feeling amongst the interviewees was that computer literacy and previous exposure to computers increased the acceptance of the POC system. This finding was also endorsed by the fact that nurses in ICU with more technology in the ward accepted the POC system better.

Advanced age also proved to decrease the acceptance levels and more time had to be spend with older nurses in order to get them on board. Therefore, in contrast with McConnell (1989) and in line with Barholomew (2004), it appeared as if older nurses were more reluctant to accept the POC system. Whether this was because of longstanding nursing practice or because of their advanced age they had less technology exposure, was unclear.

As could be expected, *mental capacity* for information retention also played a role in user acceptance of the POC system.

The positive attitude displayed by all *nursing managers* during the early phase of the POC implementation also showed how individuals in these positions felt a responsibility to stay positive and set an example to top management and their staff. An older unit manager in

one of the general wards that did not have any previous computer exposure was an excellent example of how organizational position (and the responsibility that came with it) might mitigate individual factors like age and previous exposure to technology.

7.2.2 Difference between user groups

The ward environment, type of ward and the type of nurse in the ward, all played a role in how the end users (nurses in the ward) differed in their acceptance of the POC information system.

In a positive *ward environment* where there was good general spirit (Ward H & MICU), the acceptance of the POC system appeared to be better than in wards where there was general negativity (GTICU).

The *type of ward* as mentioned by Hebert & Benbasat (1994) also played a role in acceptance of the POC system and in wards where the use of technology was the norm (for example ICU), the staff was of the opinion that exposure to technology in the ward setting improved the acceptance of technology. This also supports the fact that individuals who were previously exposed to technology, accept new technology better.

The fact that the *type of nurse* also differs from general wards to the ICU also appeared to influence their acceptance of the POC system. The more individualistic functioning ICU nurses supported each other less with the use of the POC system where general ward nurses supported each other more in solving problems related to the POC system. This observation supports the conclusion drawn in the literature review on how ICU nurses might display the same attitude as doctors due to their working conditions and autonomous practice. The peer support in Ward B transferred negative attitudes between staff and to be consistent we would expect in a positive ward that it would also transfer positive attitudes and improve the acceptance of the technology. It could therefore contribute positively or negatively towards technology acceptance depending on the greater environment.

A special mention needs to be made of the difficulties experienced in GTICU. Project management singled out GTICU as a ward that gave a lot of problems during the implementation of the POC system. In GTICU it appears as if the negative ward environment negated the possibility of better technology acceptance seen by the ICU nurses due to their increased technology awareness and "ICU nurse" characteristics.

8. CONCLUSION AND RECOMMENDATIONS

8.1 Summary

It is clear from the discussion in the previous section that the degree to which nurses, as the end users of a point-of-care information system, accepted the technology was the result of many factors. These factors included their perceptions on the usefulness and ease of use of the technology and social factors like the differences between individuals, wards, types of wards and the influence of the nursing culture. Organisational factors such as how the technology fitted into work processes, project management factors and the commitment of different levels of management also influenced the acceptance decision.

What also emerged from the case study is that the social factors played a very important role in nurses' technology acceptance decisions. What was very clear was that as a group they would not allow technology to interfere with the quality of care they provided to their patients and would gladly reject the intended use of the system if they felt that it jeopardized patient care.

The results also pointed out that there are many individual and group differences within the nursing population. Negative and positive collective attitudes towards the technology appeared to nullify individual characteristics as was the case in GTICU (negative general attitudes with poor acceptance) and in psychiatric ward (positive general attitudes with good acceptance). These differences might prove to be very valuable due to the fact that it offers hospital and project management the opportunity to identify and target possible problem areas which might lead to better system acceptance.

8.2 Recommendations

Consider technological, social and organizational factors when implementing new technology into the healthcare setting.

Clinical information system implementation appears to be a multi-factorial process and by neglecting any one of the above-mentioned areas, project management might be setting up the implementation for failure.

Target individuals and end user groups prior to and during technology implementation

Project management should consider identifying and targeting possible problem areas and individuals prior to implementation. By paying close attention to factors like personality, age and previous technology exposure on an individual level, communication and training can be targeted to focus on individuals with a higher need. An example is how young staff members in general had more technology exposure and older nurses had less. In this case study these two factors therefore usually came in combination and might help implementers target their training and energy towards users where they could make more impact.

Targeting can also be done on a ward level with the purpose of identifying wards that might be especially sensitive towards change or that might have weak nursing leadership. The intensity and workload of individual wards might also be worth considering due to the fact that if ignored, differences in the above might negatively influence technology acceptance.

With regards to the type of ward, ICU requirements and the staff working in these units might differ from other nursing units and might therefore have their own requirements regarding the technology and the fit of the technology into the work processes.

The suggestion can also be made that if management plans to implement new technology into a hospital environment, recent changes made in the macro environment should also be taken into account.

Provide optimal technological support to users of clinical information systems.

The low tolerance observed from nurses towards technology interfering with patient care in the ward setting, emphasized how nurses as a group consider patient care to be their first priority. Implementers of new technology into the clinical setting must be fully aware that anything short of a device supporting patient care optimally is very likely to be rejected by nursing staff. Not only should the device be working one hundred percent, but if the function is lost like for example through connectivity, timely and adequate support must be provided to ensure that the technology is not rejected by the nurse end user.

8.3 Suggestions for further research

While the difference between individuals in wards and differences between wards was confirmed in this research, more in depth and generalisable data are needed on these topics.

The research should especially attempt to create a better understanding of how these differences can be utilised to improve the acceptance of clinical information systems.

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10. APPENDICES

Appendix A – List of interviews (29 interviews in total)

1 (one) interview on November 4, 2004 at Afrox Healthcare, Bedfordview

1. POC system project team member

5 interviews on November 4, 2004 at Flora Clinic, Roodepoort

1. Hospital manager
2. Matron in charge of POC system
3. Nurse from general ward
4. Unit Manager from general ward
5. Unit Manager from psychiatry ward

8 interviews on November 9, 2004 at Flora Clinic, Roodepoort

1. Nurse from Medical ICU(MICU)
2. Unit Manager from General and Thoracic ICU (GTICU)
3. Nurse from GTICU
4. Caregiver (junior nurse) from oncology ward
5. Nurse from psychiatry ward
6. Unit Manager from pediatric ward
7. Unit Manager from MICU
8. Ward secretary from MICU

7 interviews on November 16, 2004 at Flora Clinic, Roodepoort

1. Unit Manager of general ward
2. Unit Manager of general ward
3. Senior nurse from general ward
4. Ward secretary from general ward
5. Unit Manager of oncology ward
6. Systems controller
7. Senior nurse from pediatric ward

3 interviews on December 1, 2004 at Flora Clinic, Roodepoort

1. Theatre complex manager
2. Anaesthetic nurse in theatres
3. Surgical nurse in theatres

3 interviews on December 8, 2004 at Flora Clinic, Roodepoort

1. Surgical nurse in theatres
2. Surgical nurse in theatres
3. Stock controller in theatres

1 (one) interview on December 15, 2004 at Afrox Healthcare, Bedfordview

1. POC system Project Manager

1 (one) interview on January 7, 2005 at Afrox Healthcare, Rosebank

1. POC system project team member

Appendix B – List of POC system project documentation used as sources of information

1. POC evaluation on 6 March 2004 – internal document
2. November 2002 Point of Care Project report – internal document
3. February 2003 Point of Care Project report – internal document
4. Point of Care audit report on 30 October 2003 – internal document
5. “What is Point of Care?” information pamphlet, , date unknown
6. Paper printout of Symbol website on 7 October 2002
7. Paper printout of Point of Care Power Point Presentation, date unknown
8. Email from matron in charge of POC system to hospital manager on 3 September 2003
9. Paper printout of article “Flora Clinic implements largest wireless network in SA” , date unknown
10. Internal document by project team member, date unknown
11. POC protocol, internal document, date unknown