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Perception and preparedness of stakeholders at hospitals to utilize a paperless environment

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Submitted in fulfilment of the requirements for the degree of
Masters in Commerce of Information Systems and Technology

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Supervisor's permission to submit for examination

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As the candidate's supervisor I agree to the submission of this study for examination. **To the best of my knowledge, the study is primarily the student's own work and the student has acknowledged all reference sources.**

The above student has also satisfied the requirements of English language competency.

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Signature:

Declaration

I, Vikash Ramharuk, declare that the study “Perception and preparedness of stakeholders at hospitals to utilize a paperless environment”, which is submitted to the Faculty of Management Studies in fulfilment of the requirements for the degree of Masters in Commerce of Information Systems and Technology, is my own work and that:

1. The research reported in this study, except where otherwise indicated, is my original research.
2. The study has not been submitted for any degree or examination at any other university.
3. The study does not contain other persons’ data, pictures, or other information, unless specifically acknowledged as being sourced from other persons.
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Name: Vikash Ramharuk

Dated:

Signature:

Acknowledgements

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Finally, I would like to dedicate this study in memory of my late parents, Mr Ramharuk and Mrs Bisnath. Without my parents none of this would have been possible.

Abstract

The embracing of Health Information Technology (HIT) by hospitals is viewed as one mechanism to mitigate the ever-growing healthcare supply and demand gap, reduce medical errors, increase efficiency, improve quality of care and automate business processes. This has led to many hospitals investing large sums of money in the hope that HIT can help hospitals achieve this goal.

The problem, however, is that similar to other industries that have undertaken this journey towards embracing Information Technology (IT), hospitals have not been very successful and have not achieved the expected benefits of IT. One of the major contributing factors to the high failure rate of IT implementation within the healthcare sector is user acceptance. The main objective of this study was to determine the perception and preparedness of clinical stakeholders to adopt a paperless environment and to determine if the clinical stakeholders were equipped with the necessary skills to be able to function within a paperless environment.

Due to the nature of the study, a quantitative approach was used to gather information using a questionnaire. The private hospital that agreed to participate in the study is from the eThekwini municipality. A total of 300 questionnaires were handed out to the nursing clerk at the hospital and a total of 102 questionnaires were successfully answered giving the researcher a response rate of 34%. The findings of the study indicate that both perceived usefulness and perceived ease of use by clinical stakeholders are enablers to HIT usage while resistance to change is an inhibitor to HIT usage. The findings also indicate that both related knowledge and perceived compatibilities have a positive effect on the perceived usefulness and perceived ease of use respectively.

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Introduction

1.1. Introduction

The Institute of Medicine (IOM) note that each year preventable medical errors cause between 44000 and 98000 hospital deaths and over 770000 people are hurt or worse even die in hospitals due to undesirable drug prescriptions worldwide (Columbus, 2002). In today's health care information systems clinical stakeholders work independently without being aware of the patients' prescriptions or adverse drug reactions determined by fellow colleagues. "Patients are being hospitalized unnecessarily; duplicate tests are being ordered; adverse drug reactions are occurring because clinicians are not aware of drugs prescribed by colleagues; and patients are receiving conflicting treatment information and advice" (Columbus, 2002). In order to minimize medical errors, increase the efficiency of medical records and enhance the methods of communication, the health care sector needs to embrace Information Technology (IT).

The potential of IT to improve the care patients receive and the overall efficiency of the health care systems has become a central part of a universal health care debate (MEDPAC, 2003). Many hospitals and health systems have embarked on the challenging journey of IT adoption. However, "even though considerable achievements have been made in the spread of IT in the health care service, widespread use of clinical systems has not yet been achieved" (Glaser, 2002). There are many reasons for this lack of IT adoption in the health care sector ranging from lack of infrastructure, financial limitations, cultural resistance and lack of insight into the benefits of information technology.

Addressing the lack of penetration of IT within the health care sector will firstly ensure that systems of the future are designed better and are functionally accepted by the end users. This would help prepare future hospitals that are intending to go paperless. On a much broader spectrum, this study, by understanding the perceptions and preparedness of stakeholders to implement a paperless environment can also be extended to other organizations that are moving towards being completely paperless environments (Glaser, 2002). Many clinical stakeholders lack the insight into these technologies or the understanding of how these technologies will affect their jobs and what the potential benefits of IT are in the health care sector. Columbus (2002) depicts the following picture of a paperless environment within a hospital by stating that: “A future clinician will likely use a computer to enter findings and diagnoses, take advantage of links that connect these with decision support modules and the medical literature, and communicate with colleagues and others taking care of the patient.” The next section elaborates on the current problems and barriers that exist in ensuring that the picture painted above become a reality and not a mere fairytale.

1.2. Problem statement

Many hospitals have invested large sums of money in the hope that information systems will improve the efficiency and quality of work, reduce medical errors and reduce administrative costs. However, similar to other industries that have undertaken this journey towards IT implementation in order to realize the potential of IT, the health care sector has also not been very successful in its IT implementation and hence have not achieved the expected benefits that IT can bring to the health care sector (Glaser, 2002).

When categorized with other industries, the health care industry over the years has lagged behind in its adoption of IT (Columbus, 2002). However, recent surveys indicate otherwise and show more investment in IT within the health care sector (Badenoch & Tomlin, 2008). Depending on the size and financial situation of the organization, the IT implemented will vary from different organizations in order to best suit the organizations' needs. For example, certain organizations will implement IT with the goal to achieve improved efficiency or improved quality of care, other organizations will implement IT to simply automate business processes in order to reduce cost and other organizations will implement IT to gain all the potential benefits expected with IT implementations. "Yet, the cost and the complexity of IT implementation, including necessary organizational and workflow redesign, pose considerable barriers, as does uncertainty regarding the stability of the IT industry" (Glaser, 2002).

A current problem facing the health care industry is that very few clinical stakeholders have access to these information systems deployed at the hospitals or have not been part of the implementation process. Badenoch and Tomlin (2008) state that only 20% - 25% of hospitals have completed integrating HIT. The possible reason for these low adoptions of HIT is the huge costs involved with HIT implementations. Badenoch and Tomlin (2008) in their study of IT resistance quote the following as other barriers to HIT adoption among hospitals:

- Connectivity; the ability to share information from system to system is poor
- IT implementation is growing, but there is little sharing of health information between existing systems. There is no market pressure to develop IT systems that can talk to each other.
- The piecemeal implementation currently underway may actually create additional barriers to the development of a future standardized system because of the high costs of replacing or converting today's non-standard systems.

- Finally, one of the most serious barriers is the disconnection between who pays for IT and who profits from IT; patients benefit from better health, and payers benefit from lower costs. However, health care providers pay in both higher costs to implement HIT and lower revenues after implementation. Hospitals that use HIT to reduce adverse drug events also reduce bed-days and reduced bed-days means reduced hospital income.

Another problem is that within South Africa the different provinces face different health care challenges and this would mean that their priorities will differ with regards to their approach to health care delivery. Mokgabudi (2006) also notes that "further perpetuating the problem is the fact that e-Health applications are expensive and, the cost of telecommunications in the country is unaffordable. This has resulted in a minimal budget for IT investment."

IT investment within the health care sector is very costly and has huge risks and implications associated with the investment. However, researchers such as Glaser (2002), Columbus (2002), and Harper (1997) are of the opinion that "in an acute hospital setting, the deployment of Information Technology is a substantial investment that any stakeholder would undertake to maximize an institution's utility, which will vary by its governance."

Even though there have been several advances in HIT such as Electronic Medical Records (EMR), handheld devices that can be used in the hospitals such as the Palm Digital Assistant (PDA) and Clinical Decision Support Systems (CDSS) which enable health care providers with the ability to have real time access to patients information there will always exist certain inhibitors to the adoption of these technologies. These include resistance to change, computer literacy, a lack of industry standards, lack of

training, human and social barriers and the cost and complexity of IT implementation. According to the Standish group's CHAOS report 26% of software projects succeed, which means that 74% fail (Legris *et al.*, 2003). The report goes on to mention that 46% of projects were over budget, and almost 28% of the projects were cancelled. Legris *et al.* (2003) also note that a significant percentage of the projects that fail are primarily due to the lack of acceptance of the systems by its intended audience. These technology acceptance barriers often come about because clinical stakeholders are required to drastically change the way they work and the means in which they provide the patient with health care, which Laerum *et al.* (2004) in their study of paperless hospitals list as the following:

- Computer literacy and computer training
- Flexibility of paper based records
- Traditional work routines
- Introduction approach to clinical applications
- Privacy, protection and confidentiality of patient data
- Resistance to change
- Organizational culture.

One of the leading inhibitors towards the adoption of HIT with many hospitals is the user acceptance (Badenoch & Tomlin, 2008). While IT in the health sector continues to rapidly evolve and transform, it is also important to understand and have an insight into user's acceptance and perceptions towards the technologies that they will be faced with on a daily basis. Davis *et al.* (1989) developed the technology acceptance model (TAM) which is intended to explain the acceptance or lack thereof of IT by its users. "A key purpose of TAM is to provide a basis for tracing the impact of external variables on internal

beliefs, attitudes, and intentions while perceived ease of use (PEOU), and perceived usefulness (PU) are the two most important factors in explaining system use" (Davis *et al.,* 1989).

In the field of information systems research, TAM is seen as one of the leading theoretical models in explaining system use. The two most important factors in the TAM model are perceived usefulness (PU) and perceived ease of use (PEOU) while behavioural intention to use (BI) and attitude towards (AT) are also used in the model to explain actual system use (U). Much research about using TAM with the above components has been done to measure the acceptance of the technology after the implementation of an IT system in an organization. However, this study will provide a preliminary study on the perception and preparedness of an organization to implement a paperless environment before the technology is implemented. The next section further elaborates on the motivation to pursue this study.

1.3. Motivation for this study

The embracing of Health Information Technology (HIT) systems throughout the world is seen as one method to mitigate the ever-growing health care supply and demand gap, reduce medical errors, improve efficiency, improve accuracy and automate business processes. However, insufficient user acceptance has long been an obstacle to the successful adoption of new information systems and information technologies within the health care sector. Studies on the potential benefits of IT in the health care sector are in abundance; however, very little research pertains to the understanding behind the reasons for the non acceptance of HIT in many hospitals (Bhattacherjee & Hikmet, 2007).

It is also beneficial to have an insight into the reasons for resisting IT among health care professionals and how these reasons affect the usage of IT applications in hospitals. Understanding the reasons for

this resistance within the healthcare sector can provide health care administrators and managers with the "ammunition" they require to put in place intervention strategies and preparing other organizations for the journey towards becoming a paperless environment. This study can also assist other organizations that want to pursue the journey towards becoming a paperless environment in understanding how IT can improve the quality of work, increase efficiency while still reducing cost. On a broader perspective, understanding this resistance has broader ramifications for other organizations that want to go paperless and prepares them in understanding some of the resistance barriers they will encounter and thereby provide guidance in designing systems that will be accepted by the users.

A truly useful study on investigating the level of preparedness and perception of stakeholders at hospitals within the eThekwini municipality to utilize a paperless environment is a study that will understand the barriers that exist that prevent clinical stakeholders from utilizing a paperless environment and the measures that can be put in place to overcome these barriers. Better data and knowledge about the perceptions and the level of preparedness of hospital staff to utilize a paperless environment will enable other organizations to not only understand the benefits that IT will bring to the organisation but some of the barriers that will need to be overcome in order to ensure that the IT implementation is a success and, most importantly, accepted by its intended users. The next section further elaborates the problems that hospitals face in the journey of IT adoption.

1.4. Objectives of the study

The purpose of the study is to investigate the clinical applications that can be utilized in the health care sector that would help evolve hospitals into becoming paperless and thereby investigating the perception and preparedness of stakeholders at hospitals within the eThekwini municipality to utilize a paperless environment. This would, thereby, provide theoretical strategies and guidance aimed at preparing future hospitals that are looking to become paperless. Therefore the objectives of this study are:

- To determine whether the perceived compatibility of clinical applications used by clinical stakeholders contributes to the perceived usefulness of the HIT in a paperless environment
- To investigate whether clinical stakeholders will use the clinical applications in a paperless environment if it is perceived to be useful to them in conducting their daily activities
- To determine whether the related knowledge of computers and training of clinical applications used in hospitals will contribute to clinical stakeholders perceiving the clinical applications in a paperless environment as easy to use
- To investigate whether clinical stakeholders will use the clinical applications in a paperless environment if it is perceived to be easy to use in assisting them to conduct their daily activities
- To investigate whether the clinical applications in a paperless environment will be perceived as a threat to the clinical stakeholders which lead them to resisting the technology
- To investigate whether resistance to HIT by clinical stakeholders contributes negatively towards the perceived usefulness of HIT
- To investigate whether resistance to HIT by clinical stakeholders contributes negatively towards the perceived ease of use of HIT
- To determine the reasons for resistance to change by clinical stakeholders in moving towards a paperless environment

- To determine the computer knowledge and skills of clinical stakeholders.

1.5. Outline of the study

The main theme of this study is the understanding of the perceptions and preparedness of stakeholders in hospitals to implement a paperless environment and, furthermore, in addressing the reasons for user's non acceptance of technologies that are proposed to potentially be beneficial to health care providers and patients' best interests if implemented. The study is divided into five chapters:

- **Chapter 1**

  Chapter 1 is an introduction to the study and discusses the current state of HIT in hospitals throughout the world including South Africa. The chapter also elaborates on the current problems faced by organizations that want to go the paperless route in the problem statement. The research objectives are also set out together with an outline of the study and finally the limitations of the study are also mentioned.

- **Chapter 2**

  Chapter 2 details all of the relevant literature that pertains to the study. This literature survey is the result of the outcome to attempt and study the totality of the impact of service delivery on a paperless hospital in a developing country. Chapter 2 reviews literature on paperless hospitals and explores the evolutionary nature of clinical IT adoption. The research questions that will be answered by the findings of the study are also discussed in this chapter.

- **Chapter 3**

In chapter 3, the research methodology that was followed is discussed in detail. The research design, sampling procedure, data collection method, question format, frequencies and analysis procedures are discussed.

- **Chapter 4**

Chapter 4 presents the findings and analysis of the study using statistical package for the social sciences (SPSS) 17.0 for Windows. The validity and reliability of the research instrument is also tested using Factor Analysis and, finally, the research model used for the study is quantified using the Partial Least Squares (PLS) technique.

- **Chapter 5**

Chapter 5 provides a conclusion of the study and a quantitative study of the findings are provided by answering the questions set out in chapter 2 of the study. In addition, recommendations for other organizations that want to undertake the journey towards being a paperless environment are described together with future research and, finally, some the limitations of the study are outlined.

1.6. Limitations of the study

This study is conducted in an environment where the potential benefits of IT are not well understood and where there exists certain acceptability barriers to IT. Such circumstances could limit access to information from respondents during the study. This could lead to a restricted sample size and a limited response rate. The researcher will, however, compensate for this limitation by including extensive literature done by other researchers in the field of paperless hospitals and the use of HIT in hospitals.

The researcher was only limited to one hospital for the study and this was primarily due to many hospitals not wanting to participate in the study. Due to many constraints including budget and timeliness the researcher was not able to visit every hospital within the eThekwini municipality to verify the level of preparedness of hospitals to implement a paperless environment. The study will, therefore, use the one hospital as a case study.

1.7. Conclusion

Fifteen years ago it was possible to send money electronically from India to Germany, fifteen years ago it was possible to book a ticket online from Madras to Buenos Aeries, 10 years ago it was possible to book a hotel room in Australia from India but today it is not possible to transfer a patient's medical record from one hospital to another hospital (Vaidya, 2007). Vaidya further states that at least 10 percent and often more than 25 percent of commonly ordered diagnostic tests are found to be redundant. However, it is not all gloom and doom in the health sector. Moving towards paperless hospitals is the next step to bridging the divide that is faced in the health care sector.

The next section provides a comprehensive picture of paperless hospitals and more especially the adoption of IT within hospitals. It first discusses adoption of the most comprehensive clinical IT tools such as Electronic Health Records (EHR), Computerized Provider Order Entry (CPOE), hand held devices and bar coding systems. It then explores the evolutionary nature of clinical IT adoption, which often involves implementation over time of separate systems in different departments of the hospital, such as the pharmacy or laboratory, that provide data to the EHR. The next chapter also places hospitals along a spectrum of IT adoption and considers the factors that drive greater IT use.

Chapter Two

Literature Review

2.1. Introduction

This literature survey is the result of the outcome to investigate the perception and preparedness of stakeholders at hospitals within the eThekwini municipality to utilize a paperless environment. The main focus will thus be on literature that provides insights to factors that contribute to users accepting or rejecting technologies within the health care sector and possible solutions to overcome some of these barriers. The literature review comprises of relevant studies on paperless environments and paperless hospitals throughout the world and also includes other influential topics such as the use of Information and Communication Technologies (ICT) within the health care sector, resistance to change and technology barriers. In addition to that the following additional influential topics were also used in the study:

- Utilization of HIT in the health care sector
- Adoption of IT within the health care sector
- Electronic Medical Records
- IT barriers
- Technology acceptance theories and models
- The TAM
- Technology perceptions of health care professionals.

The literature review is an important part of any research in the field of information systems. According to Leedy (1993) the literature review "shows the researcher what has been done in relation to the

problem that the researcher is investigating." This will help ensure that the researcher attempts to solve or investigate a problem that has not been solved by another researcher.

2.2. Technology acceptance in the health care industry

"The Institute of Medicine has reported that more than 1 million preventable adverse events occur each year of which 44 000 to 98 000 are fatal and more people die in a given year as a result of medical error than from motor vehicle accidents, breast cancer, or AIDS" (Colombus, 2000). Therefore, by eliminating or reducing medical errors in hospitals, the alarming statistics above can be drastically reduced, thereby, increasing the number of lives saved and reducing costs (Parente, 2003). The health care sector, therefore, needs to start reducing the number of preventable medical errors and one way of achieving this is for the health care sector to start embracing IT (Colombus, 2000). However, a major stumbling block is that IT system implementations are expensive and have a relatively low success rate. Lewis (2003) notes that IT implementations are a complex and challenging interplay of people, techniques, cultures and technology and lists many reasons for IT system implementation failures such as computer phobia, resistance to change, computer literacy, lack of industry standards and training, human and social barriers, the significant costs associated with IT implementations and technology acceptance. From these many reasons stated for IT implementation failures one that is undeniably prominent is technology acceptance. Therefore, it is important to acknowledge the contributing factors that lead to the non acceptance of HIT by clinical stakeholders in hospitals.

Many organizations decide to implement IT systems in order to streamline business processes, cut costs, automate processes, lower costs without compromising on quality and improve organizations' services. Despite these huge investments in information systems, a study by the Standish group's CHAOS reports

26% of software projects succeed, and 46% of projects were over budget, and almost 28% of the projects were cancelled (Legris *et al.,* 2003). The report also goes on to note that a significant percentage of the projects that fail are primarily due to the lack of acceptance of the systems by its intended audience.

One of the leading inhibitors towards the adoption of HIT with many hospitals is user acceptance (Columbus, 2002). It is, therefore, important to have an insight into users' acceptance and perceptions towards the technologies that they will be faced to use on a daily basis. There are two important factors required to be taken into consideration when attempting to ensure that the information system implementation is successfully adopted by its end-users. These factors can be broken down into the attitude towards the information system and the acceptance of the information system (Venkatesh & Davis, 2000). "The more accepting of a new information system the users are, the more willing they are to make changes in their practices and use their time and effort to actually start using the new information system" (Succi & Walter, 1999)

Pikkarainen *et al.* (2004), in their study of consumer acceptance note that "a system that satisfies users' needs reinforces satisfaction with the system and is a perceptual or subjective measure of system success i.e. similarly; usage of a system can be an indicator of information system success and computer acceptance in some cases." If a system is not reliable and the information it provides end users with is incorrect then this could negatively affect the end users' behaviour towards the system. It is, therefore, vital to understand the reasons for the negative perceptions and use or lack thereof of information systems because a system that an end user regards as ineffective will not be perceived as helpful and result in non acceptance of the system by the intended users.

2.2.1. The technology acceptance model (TAM)

In the field of information systems research, TAM is seen as one of the leading theoretical models in explaining system use. TAM was modelled from Ajzen and Fishbein's Theory of Reasoned Action (TRA) which is mainly used for studies in the field of attitude and behaviour relationships towards information systems and has been used and related in many other fields or research and academic studies (Bhattacherjee & Hikmet, 2007). In a study of creating a research model to examine academics acceptance of Internet usage, Kripanont (2007) noted that there are nine leading technology acceptance models or theories, namely:

- Innovation Diffusion Theory (IDT)
- Social Cognitive Theory (SCT)
- Theory of Reasoned Action (TRA)
- Theory of Planned Behaviour(TPB)
- Decomposed Theory of Planned Behaviour (DTPB)
- Technology Acceptance Model (TAM)
- Technology Acceptance Model 2(TAM2)
- Combined TAM and TPB(C-TAM-TPB)
- The Unified Theory of Acceptance and Use of Technology (UTAUT)

The next section elaborates more on the TAM model, the different components that make up the TAM model and goes on to explain the reasons for TAM being the preferred, accepted theoretical model in the study of information system acceptance.

2.2.1.1. TAM background

Davis *et al.* (1989) developed the technology acceptance model (TAM) which is intended to explain the acceptance or lack thereof of IT by its users. The TAM model consists of perceived usefulness (PU), perceived ease of use (PEOU), while behavioural intention to use (BI) and attitude towards (AT) are also used in the model to explain actual system use (U).

In trying to explain system use the two most important factors in the TAM model are perceived ease of use (PEOU) and perceived usefulness (PU). “Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance, while perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort” (*Davis et al.*, 1989). Figure 2.1 is the original TAM diagram created by Davis (1989) and indicates that PU impacts on the behavioural intention to use and PEOU impacts on both PU and behavioural intention to use. These factors help information system managers, measure and predict the system usage on systems that organizations intend to implement and also assist vendors in getting new ideas depending on the usage of the technology. “Generally, TAM specifies general determinants of individual technology acceptance and, therefore, can be and has been applied to explain or predict individual behaviours across a broad range of end user computing technologies and user groups” (Kripanont, 2007).

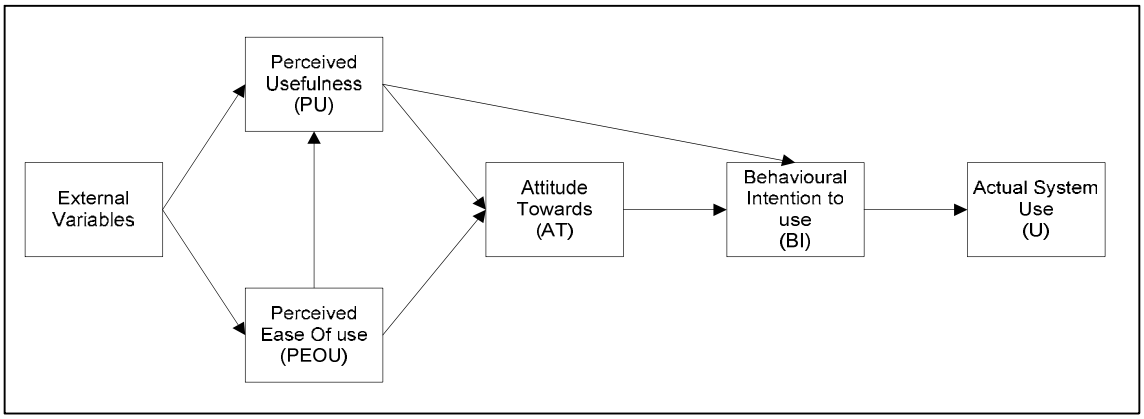

Figure 2.1: Original Technology Acceptance Model (Davis, 2000)

In essence, the TAM's goal is to establish the factors of information system acceptance that assists in determining the behaviors across a range of different technologies and end users whilst still being theoretically correct. In the TAM model, examples of external variables can be seen as training, beliefs, employee behaviors, time to learn, privacy, protection of confidentiality, resistance to change, and organizational culture. It is these external factors that ultimately indicate the intended use of a certain system which is mediated by PU and PEOU. Venkatesh and Davis (2000) further elaborate this fact by stating that PU is influenced by PEOU because if a system or technology is apparently easy to use then the more useful will the system or technology then be to the users.

TAM has also been extensively tested across different organizations using different sample sizes and groups and also been measured up against other leading technology acceptance models. "In ten years, TAM has become well-established as a robust, powerful, and parsimonious model for predicting user acceptance" (Venkatesh & Davis 2000). Davis (1989) stipulates that the TAM has the following three main assumptions:

- Usage of a particular technology is voluntary

- Given sufficient time and knowledge about a particular behavioural activity, an individual's stated preference to perform the activity (i.e. behavioural intention) will in fact closely resemble the way they do behave
- When someone forms an intention to act, they will be free to act without limitation.

Kripanont (2007), in contradiction, notes that in many cases today the third assumption mentioned above may not be the case due to external constraints such as time constraints, organizational culture, training and technology limitations which could limit ones freedom to act.

Even though TAM continues to be considered as the most widely accepted theory for measuring and describing an individual's acceptance towards information systems, social and control factors have an influence on information system usage but TAM does not include these factors. In another study to understand physicians' resistance towards health care information technology conducted by Bhattacherjee and Hikmet (2007), it is noted that TAM has another flaw which is that it "concentrates exclusively on users positive perceptions of IT usage which is the perceived usefulness and perceived ease of use whilst ignoring the negative perceptions that may inhibit IT usage." However, research has shown that negative perceptions do act as inhibitors to IT usage. The next section discusses extensions to the TAM model to overcome the TAM barriers indicated above and discusses in detail the acceptance model that will be used for this study.

2.2.1.2. Research model used in this study

Research explaining and demonstrating the potential that IT can bring to the health care sector including Electronic Medical Records (EMR), Computerized Provider Order Entry (CPOE), Clinical Decision Support Systems (CDSS) and hand held technologies are in abundance. However, research explaining

reasons for resistance towards information technology and explaining the effect that resistance has on information technology usage is few and far between.

In trying to incorporate the inhibiting factors to HIT acceptance such as resistance to the TAM model which primarily focuses on the positive factors of IT usage, Bhattacherjee and Hikmet (2007) created a dual factor research model. The dual factor model concludes that the information technology usage considerations in a target population of potential users are determined by measuring the enabling and inhibiting factors of systems usage simultaneously. In the dual factor model, the inhibitors are defined as negative factors that adversely affect systems usage when present. However, when unavailable they do not improve system usage, meaning that "inhibitors are not quite the opposite of enablers, but are qualitatively distinct constructs that are independent of but may coexist with enablers" (Bhattacherjee & Hikmet, 2007). Figure 2.2 depicts the research model created by Bhattacherjee and Hikmet (2007), which bridges the gap between usage and change resistance of IT in an integrated model.

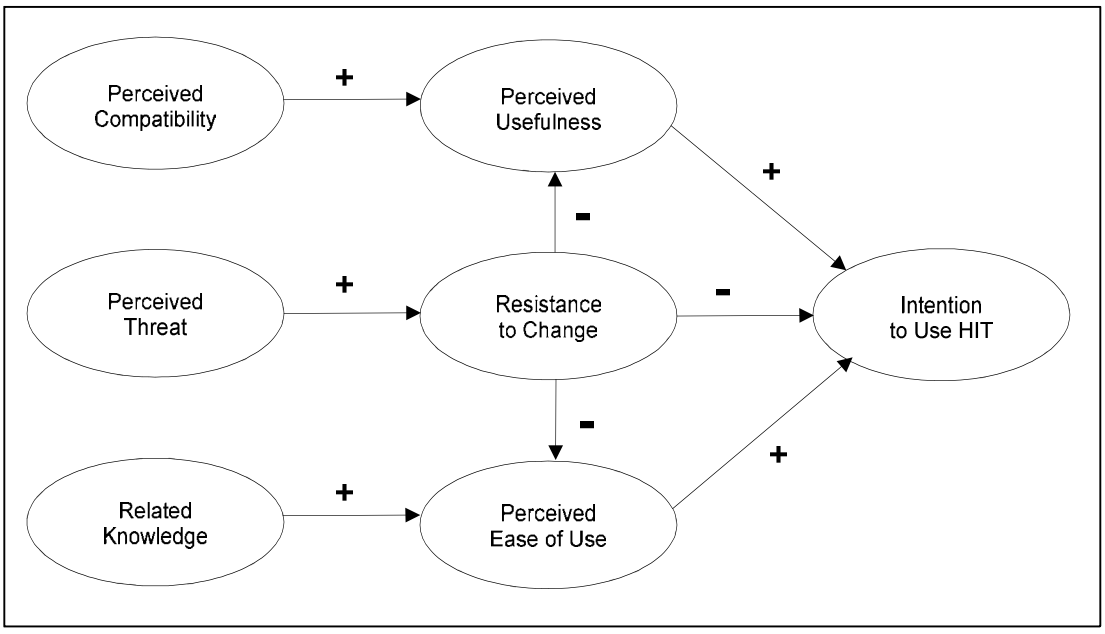

Figure 2.2: Research model used in study (Bhattacherjee & Hikmet, 2007)

In addition to the usual enablers of information system usage being the PEOU and the PU, Figure 2.2 also indicates that resistance to change is seen as an inhibitor to HIT usage. In the same manner, it can be hypothesized that resistance to change are inhibitors to both PU and PEOU while related knowledge, perceived threat and perceived compatibility can all be seen as enablers of perceived ease of use, resistance to change and perceived usefulness respectively. Therefore, the research model created by Bhattacherjee and Hikmet (2007) is the proposed model to be used in this study in order to achieve its objectives. Using this model, the researcher will be able to demonstrate the impacts of enabling and inhibiting perceptions and preparedness of information technology usage in hospital, thereby, providing theoretical strategies and guidance aimed at preparing future hospitals that are looking to become paperless.

It is important to note that IT is one part of an organizations entire information system. Information systems are defined as the "overall information processing in an organization, including the involved human players and the information technology used" (Ammenwerth, 2003). It is important to note that it is not only the technology that is important in deciding whether or not an information system is a success or not but the actual interaction between the human players and the technology itself is also very important. The preceding section, therefore, discusses further the role that information technology has on the health care sector.

2.3. The role of information technology (IT) in health care

The health care sector is under "tremendous pressure to address a host of system ills; medical errors, rising costs, inconsistent quality, inefficiency, declining clinician job satisfaction, and mounting staffing shortages" (Johnston *et al.,* 2002). Many researchers such as Parente (2003), Lawrence Van Horn

(2003), Raghupathi (2000) and Adlington (2007) agree that using IT in the health care sector can address some of the issues and go a long way towards improving the quality and efficiency of health care.

The use of HIT has been promoted as having tremendous promise in improving the quality of care, efficiency of clinical stakeholders in hospitals and reducing costs. Throughout the world, many hospitals are embarking on the journey of IT adoption with the specific goal of improving patient care (Aldington, 2007).

The technology available in the health care sector today ranges from online prescriptions to Electronic Medical Records (EMRs) to incredibly fast Intranets that provide real time analysis of a patient's condition (Columbus, 2002). Most processes in a hospital system can be done electronically and the next generation of IT in health care is the realization of paperless hospitals.

"Advances in information technology can provide the foundation for important improvements in health care delivery, such as more cost-effective monitoring and follow-up of patients beyond health care centres and dynamic, optimal targeting of specific sectors of the population for special education, screening, and early treatment where necessary" (Reddy, 2001). "Information technology can also help to provide better feedback loops for connecting providers, policymakers, and patients with the latest research and discussions about clinical decision-making policy both for the generation of new epidemiological knowledge and for the generation of prudent health policy" (Johnston *et al.*, 2002).

There are different interpretations of technology in hospitals and it is, therefore, important to define the different types of information technologies. The next section therefore describes in detail the different types of technologies available in hospitals and how they can be utilized to improve service delivery.

2.3.1. Information technology in hospitals

Shea and Clayton (1999) indicate that information systems in the health care sector can be categorized into four areas, namely: "improving access to medical knowledge, electronic patient/medical records, communication improvements among providers, and decision support systems." For the purpose of this study, however, the researcher will concentrate on how these categories affect service delivery in a paperless hospital.

Parente and Van Horn (2003) note that "patient care related IT systems are a necessary but not sufficient technology to improve medical decision-making and these systems provide an opportunity to improve the efficiency of a hospital by lowering the costs of clinical data collection and analysis. Because less time is required to track a patient through a hospital, it is possible to more efficiently treat patients at a lower marginal cost, while increasing the throughput of an institution in order to treat more patients."

Hammond *et al.,* (1990) "found that a provider interactive medical record system can favourably influence both the costs and the quality of medical care." Parente and Dunbar (2001) "found that hospitals with integrated information systems have higher total and operating margins than those hospitals that do not have integrated information systems." Neumann *et al.,* (1996) reviewed eleven studies with regards to the role of IT in hospitals in the United States of America and presented a "consolidated analysis of each. They found that fully automating administrative functions could save

between $5 and $8 billion annually" (given the current dollar to rand exchange rate of 8 rand for 1 dollar, put into a South African context that accumulates to a saving of between R40 and R64 billion every year).

2.3.1.1 Current status of IT in hospitals

Using IT to improve the manner in which the nurses, doctors and patients access medical information will not only improve the quality and safety of health care in hospitals but also increase the efficiency of health care. However, the Medical Practitioners Association (MEDPAC, 2003) reveals that "relatively few health care providers have fully adopted IT and that low diffusion is due partly to the complexity of IT investment, which goes beyond acquiring technology to changing work processes and cultures, and ensuring that physicians, nurses, and other staff use it."

In order to achieve quality health care it requires that nurses, doctors and patients in hospitals gather separated health care information from disparate sources. This would, therefore, increase the ability of clinical stakeholders in hospitals to readily access patient information where and when it is required which will improve the quality of patient care. "The ability for patients to obtain information to better manage their condition and to communicate with the health system could also improve the efficiency and quality of care" (Rosenfeld & Mendelson, 2004).

In general, IT today in hospitals is a way to help health care providers with a means of collecting, storing, retrieving, and transferring patient information electronically. However, Devers and Liu (2004) state that the "more specific discussion of IT in hospitals is challenging due to the lack of precise definitions, the volume of applications, and a rapid pace of change in technology."

There are many different technologies used in hospitals today and most of these disparate technologies and, more often than not, work independently from each other. Brailer and Teraswara (2003) in their study mention that IT diffusion is greatest in administrative and financial applications such as patient registration, billing, and payroll whereas clinical applications, such as computerized provider order entry (CPOE) for drugs or other items (e.g., lab work) and electronic health records are less diffused. The capability of clinical applications that exist today has the potential of ensuring that the health care sector achieving its goal of improving the quality of care, increasing efficiency and reducing cost. The next section, therefore, discusses what opportunities exist within the health care sector using some of these technologies.

2.3.2. Health care information technology (IT) opportunities

Information and communication technologies (ICT) have the ability to increase efficiency and improve quality of care while still reducing administrative costs (WITSA, 2006). The world information technology and services alliance (WITSA) also notes that "improving health involves improving public health and medical programs designed to provide elective, emergency and long-term clinical care, educating people, improving nutrition and hygiene, and providing more sanitary living conditions."

Within the health care sector, technologies have always been used in an attempt to improve the quality of care given to the patient. According to the world health organization (WHO, 2004) technologies form the "backbone of the services to prevent, diagnose and treat illness and disease and can be seen as tools that can be used to improve health care provided that the right policies, organization, resources and institutions are in place."

In today's world the manner in which people communicate with each other has drastically changed. "Mobile telephony, electronic mail and videoconferencing offer new options for sharing perspectives while digital technologies are making visual images and the voices of people more accessible through radio, TV, video, portable disk players and the Internet" (WITSA, 2006). However, even though the method of communicating has been modernized, the health care sector has still lagged behind and many hospitals continue to issue paper based medical records. Paper based medical records, however, can be used for malicious intent if fallen into the wrong hands and a patient's confidentiality could be at risk (Glaser, 2002). Advances in IT, particularly in the health care sector have illustrated that EMR should replace paper based medical records for a number of reasons including transportability, confidentiality, security and privacy of patient data, administration of paper records and the accessibility of patient information through an electronic medium as compared to a paper based medium.

With all of these technologies available to the health care sector the next step would be to use these technologies to not only improve the access to health care and health care information but also to ensure that it is delivered with the highest quality. In the next section the researcher documents the link between HIT and quality in the health care sector.

2.3.3. Use of IT to improve quality

In order to improve the quality of health care given to patients, one important necessity is to have the ability to obtain the relevant information when it is needed by the clinical stakeholders in hospitals (Parente & Van Horn, 2003). The challenge, however, in achieving this goal is that the information required is not static and continues to change and the sources of the information are sometimes disparate systems with little or no integration. A solution to this disparate patient information is the use of IT in

the form of clinical applications such as EMR, Computerized Provider Order Entry (CPOE), Clinical Decision Support Systems (CDSS) and hand held devices (Parente & Van Horn, 2003).

Bar coding is another information system that can also be used at the patients' bedside to improve the quality of care given to patients. For example, bar coding can be used to advise the clinical stakeholders of adverse drug reactions. Other studies indicate that bar coding reduces the incorrect medical prescriptions being given out and reduces adverse drug conditions (Oren *et al.,* 2003; Bates & Gawande 2003). Electronic health records have the ability to provide information about the patient when and where it is required because of its electronic medium. The ability to have patient information readily accessible, real time analysis, automating of business process and reminders of appointments are some functionalities that HIT provides can go a long way in ensuring that the quality of care is vastly improved within the healthcare communities (Oren *et al.,* 2003).

Information technology within the health care sector is believed to be the medium to reduce costs, increase efficiency, improve quality of care and reduce medical errors inter alia (Glaser, 2002). However, more specific detail is required on the clinical applications that can be used to achieve these goals in a paperless environment, together with their advantages and disadvantages to implementing these technologies (Parente, 2003). Other barriers are the rapid change of HIT and the lack of knowledge and training in these clinical applications. The next chapter, therefore, discusses the technologies available in health care in more detail. Some of the technologies available include Electronic Medical Records (EMR), Computerized Provider Order Entry (CPOE), Clinical Decision Support Systems (CDSS), Picture Archiving and Communications System (PACS), bar coding and handheld devices.

2.4. Clinical applications available in hospitals

Clinical applications available today in the health care sector have the ability to drive health care systems in hospitals to a higher quality and more specifically they possess the ability to close the quality gap by enhancing the care given to patients, improving the efficiency of nurses, doctors and patients in hospitals and minimizing the administrative cost that previously required manual intervention (Parente & Van Horn, 2003). One of these applications is the EMR which is an electronic means of accessing and storing patient information and has the ability to provide real time access to information, make patients' medical history more transportable and accessible and improves the security and confidentiality of patient data (Parente, 2003). The next section further elaborates on the potential benefits of EMR.

2.4.1. Electronic medical records (EMR)

The adoption of EMR within the health care sector has not grown with the same speed as compared to other technologies in other industries. Despite many websites providing users with the ability to put an individual's medical record online, and certain organizations having moved towards the EMR, many patient records are still paper-based and kept in one location (Rosenfeld & Mendelson, 2004). The challenge, however, that many hospitals are faced with is that they are required to streamline their processes such as introducing EMR but still maintain the patients' data integrity, confidentiality and privacy. The journey towards the use of EMR instead of the cumbersome paper-based records can be viewed as a step in the direction of becoming a paperless environment and improving the quality and efficiency of care.

Goodman *et al.*, (2005) summarizes IT in the health care sector as "applications of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing,

and use of health care information, data, and knowledge for communication and decision-making." An important aspect of a paperless environment in a hospital is the EMR which electronically stores the patients' information and is accessible to the healthcare provider when and where it is needed. The EMR "supports ordering prescriptions and tests, informing clinical decisions, and developing a longitudinal record of events, decisions, viewing, ordering, messaging, documenting, care management, analysis, reporting and information pertaining to a patient's care" (Goodman *et al.*, 2005).

Among the health care community, the EMR is seen as the most effective clinical tool to improve the quality of care because of its wide range of functionality and improved capabilities (Miller & Sim, 2004). Researchers such as Rosenfeld (2004), Mendelson (2004) and Giversen (2002) in their studies have demonstrated the benefits that EMR bring to hospitals such as improved accessibility, patient reminders, and online ordering. The next section discusses some of the benefits of implementing electronic medical records in hospitals.

2.4.1.1. Advantages of implementing EMR in hospitals

One important benefit of EMR is that they are very efficient. The problem with the old aged paper-based medical records is that more often than not if a patient decided to visit more than one hospital then this lead to inconsistency in the patient's medical record meaning that it was not completed or updated most of the time (Mendelson, 2004). Contrary to this using EMR the clinical stakeholder is a click away from bringing up the patient's complete and updated health information. This also improves the turnaround time to deal with patient enquiries. With a paper based medical record the patient with a query with either have to wait a long time while the patients' record is manually retrieved but with an EMR, this can be achieved immediately (Giversen , 2002).

Another important benefit of EMR is that of increased quality of care. EMR also improve the quality of care provided to the patients by ensuring that patients that require regular checkups are informed. EMR can also check for drug interactions when prescriptions are written (Giversen, 2002). Practice-wide, EMR can assist clinical stakeholders with population-based medicine; looking, for example, at diabetic patients" (Miller & Sim, 2004). Gattiker and Giversen, 2002 also noted that if the EMR is correctly implemented it can be used for things such as reporting and documentation which could be in line with the organizations quality improvement initiatives.

Health executives that invest money in EMR would also like to see the cost benefit of such implementations beside the increased quality and efficiency and this can sometimes be difficult to reflect if the EMR implementation was done recently in a hospital (Miller & Sim, 2004). EMR can also be implemented with the goal of achieving fewer incorrect charges, increase revenue and fewer claims by patients (Rosenfeld & Mendelson, 2004). Miller and Sim (2004) sum up the benefits of implementing EMR in hospitals into the following points:

- Cost reduction
- Reduced expenses
- Enhanced automation of business processes such as communication between different departments in a hospital
- Reduced queries regarding test results and patient prescriptions
- Correct visitation charging of patients
- Fewer fraudulent medical claims.

"The aim of an EMR is to improve patient care, improve the communication and coordination of care between primary and secondary health care services, monitor the health of populations, and undertake primary care research." (Rosenfeld & Mendelson, 2004). Other concerns regarding EMR's pertaining to confidentiality, privacy and protection of patients' information have also been addressed (Goodman *et al.*, 2005). Additionally, there is no clear indication that clinical stakeholders in hospitals at the point of contact with a patient using the EMR would capture fewer information related to the patient as compared to capturing the information via the traditional paper based medical record. Neither would using an EMR entail the clinical stakeholder remembering less information about the patient as compared to using paper based records. "EMR are legible and more accessible, plus EMR have the added advantage of a coded structure, enabling the automated restructuring of records, queries on data such as disease registers, decision support systems, speed, guidance, validation of data input, and electronic messaging e.g. for laboratory results." (Gattiker & Giversen, 2002). Columbus (2002) also lists other advantages of EMR such as:

- Cost savings and decrease in workplace inefficiencies
- Increased storage capabilities over a period of time compared to paper based records
- Accessibility of medical records from different sites
- EMR have the ability to provide medical alerts and reminders
- Increased flexibility in reporting on patient information
- Improved risk management
- Much more accurate billing information and electronic claims.

Having summed up some of the benefits of implementing electronic medical records (EMR) in hospitals it is appropriate to state some of the barriers to this clinical tool. The next section goes into detail about these barriers of implementing EMR in hospitals.

2.4.1.2. Disadvantages of implementing EMR in hospitals

Understanding the level of EMR capabilities in hospitals is a challenge in the healthcare industry today. Healthcare Information and Management Systems Society (HIMSS) has created an EMR Adoption Model that identifies the seven levels EMR capabilities ranging from the initial CDR environment through to a paperless EMR environment and notes that 0% of hospitals worldwide have reached stage seven while only 8.1% have reached stage 3 which is clinical documentation and PACS (Garets & Davis, 2009).

This is a clear indication of the resistance towards EMR by health care stakeholders and still remains as a challenge. Furthermore, when an EMR system is implemented in a hospital there are large costs associated with the implementation. However, these costs can be justified provided that the implementation of EMR will increase the quality of care, increase productivity and reduce cost in the long run. EMR generally requires clinical stakeholders in hospitals that are computer literate to access them as they are integrated with the computer. This would mean that, firstly, the health care stakeholders require basic computer literacy training in addition to extensive training on EMR itself. Without training or a lack of knowledge about the information system, users are generally sceptical about the application leading them to perceive the tool as both not useful to them and not very easy to use leading to a lack of acceptance of the tool, which then ultimately means a failure of the implementation (Lium *et al.*, 2007).

The actual reason for the lack of acceptance of EMR varies among the different hospitals and sometimes ranges from the lack of training, computer phobia and to the manner in which the EMR has implemented in the hospitals (Gattiker & Giversen, 2002). Ellingsen (2001) states that EMR has merely enhanced existing activities conducted by the clinical stakeholders rather than establishing new methods of working and that one reason for this is the similarity between the paper based medical record and the EMR. However, Tipirneni (2006) argues that another problem of EMR implementation is that it is still too similar to the paper based medical record, which entailed just automating certain existing activities rather than completely changing the manner in which daily activities are conducted.

Another problem is that in many hospitals the patient is still offered the option of either choosing the paper based record or the EMR, meaning that the hospital has both types of medical records running in parallel (Ellingsen, 2001). Running both systems in parallel also leads to data inconsistency and increases overall cost (Tipirneni, 2006). Taking these points into consideration, the running of both systems in parallel should not be encouraged but rather all the records should be stored electronically.
Giversen (2002) states that "the implementation of electronic health records in health care calls for the solution of a wide range of problems but only if electronic medical records are implemented in such a way to assure the best possible level of confidentiality, integrity, availability and accountability (CIAA) regarding medical information and databases." This does not, however, go to say that EMR implementations in hospitals will solve all the problems. It does, however, give hospitals the benefit of accessing a patient's data electronically at a click of a button. The next section discusses a similar technology called CPOE which is necessary for hospitals to have in place in the pursuit of becoming a paperless environment.

2.4.2. Computerized Provider Order Entry (CPOE)

Computerized Provider Order Entry (CPOE) is a clinical application that accepts clinical stakeholders orders and provides clinical decision support. Some of CPOE functionality includes medication scripts, diagnostic studies including laboratory tests, ancillary services, nursing orders and consultation request (Doolan & Bates, 2002).

The CPOE has grown in stature recently especially in the field of improving the quality of care within the health care sector. Several studies also indicate the apparent effectiveness of CPOE in assisting in the reduction of medical errors and incorrect prescriptions (Doolan & Bates, 2002). The next section discusses in more detail some of the benefits of implementing CPOEs in hospitals.

2.4.2.1. Advantages of implementing the CPOE systems in hospitals

A basic understanding of the CPOE is that it is a clinical application that replaces the traditional way of hand written prescriptions by electronically taking an order by the clinical stakeholder on a prescription pad which then enables the clinical stakeholder to support the patient at the point of contact. Information regarding the status of the medication, restrictions, cost, and alternatives can be provided at the time of ordering in a CPOE system (Ash *et al.,* 2006). The ability to quickly change information presented to the patients can be extremely valuable. CPOE also provides the additional functionality of restricting the ordering of medication that could be either not available or medication that shouldn't be prescribed and streamlines the ordering process for patients and hospitals (Sengstack *et al.,* 2005).

In a nutshell, the potential benefits of CPOE implementations are reduced medical errors, improved efficiency, and a higher quality of delivery of care. Doolan and Bates (2002) state that some of the other advantages of CPOE include:

- Cost reduction
- Increased revenue
- Improved productivity
- Enhanced clinical decision-making
- Reduction in medical errors and incorrect prescriptions
- Key stakeholders satisfaction due to improved waiting times for patients and improved overall access to healthcare information
- Increase in adherence to healthcare standards.

However, CPOE implementations still remain a challenge as it is very costly, and requires commitment from all the relevant stakeholders. The low adoption rate indicates that these are valid challenges and need to be overcome in order to implement CPOE in a paperless environment (Doolan & Bates, 2002). The next section discusses some of the disadvantages of using CPOE in hospitals.

2.4.2.2. Disadvantages of implementing CPOE systems in hospitals

There exist several different reasons for the slow adoption of CPOE within the health care sector. Some of the reasons included but are not limited to, are the complexity of CPOE implementations, non-acceptance of CPOE usage by clinical stakeholders, and poor development by vendors as they do not take into consideration the clinical stakeholders needs (Sengstack *et al.,* 2005). Other barriers to CPOE usage include awkward interfaces, poor automation of business processes and the lack of clinical stakeholders input in the design of the information system, of which all lead to CPOE system implementation failures (Ash *et al.,* 2006).

There have always been disadvantages with using CPOE in hospitals and "more than twenty years ago these were identified as lack of involvement by clinicians, inadequate, long-term financial commitment, poor planning and implementation, substandard functionality and reliability of the technology, and lack of standardization of medical terminology" (Doolan & Bates, 2002). Unfortunately, many of these barriers still persist today and Sengstack *et al.*, (2005), state that that other disadvantages of CPOE usage in hospitals include:

- Current CPOE require clinical stakeholders in hospitals to change the way they currently conduct their daily activities such as entering and ordering of data
- CPOE require additional time to process complex requirements and non-routine activities
- CPOE continuously require additional software and hardware requirements
- CPOE tend to lead to miscommunication between the different departments within the hospital
- New errors tend to pop up with CPOE implementations
- The clinical stakeholders in hospitals require extensive training on basic computer literacy training as well as the CPOE itself.

A current problem within the health care sector is the increase in medical errors which ultimately leads to patients either becoming seriously ill or to ill fated death. These medical errors also increase the amount of resources required and increase costs (Sengstack *et al.*, 2005). The implementation of CPOE can be implemented with the goal to reduce these medical errors in hospitals, however, this should not be the only mechanism that health care stakeholders bank on in order to reduce the medical error problem. Subramanian *et al.*, (2007) state that the implementation of CPOE together with Clinical Decision Support Systems (CDSS) is a solution to mitigating the number of incorrect medical

prescriptions. The next section further elaborates on CDSS and the benefits together with some of its barriers within the health care sector.

2.4.3. Clinical Decision Support Systems (CDSS)

As the name of the clinical application suggests, a CDSS is a tool that enables clinical stakeholders to make informed clinical decisions. Musen *et al.,* (2006) indicate that CDSS have the potential benefit when implemented correctly in many hospitals to increase efficiency, improve the quality of care and decrease unsuitable antimicrobial use in inpatient and outpatient settings in hospitals. Other benefits of CDSS include "familiar reactive alerts and reminders (such as alerts for drug allergies and interactions), but also many other intervention types, including structured order forms that promote correct entries, pick lists and patient-specific dose checking, proactive guideline support to prevent errors of omission (such as ensuring that appropriate patients are placed on aspirin), medication reference information for patients, and any other knowledge-driven interventions that can promote safety, education, communication, and improved quality of care" (Subramanian *et al.,* 2007).

There always has existed a problem regarding the safety and cost effectiveness of medicine within hospitals (Rosenfeld, 2004). CDSS, in its most basic capability, is able to mitigate some of these issues raised by having functionality such as, a catalogue of all the drugs, user friendly interfaces illustrating all the required parameters for a drug prescription and assistance with medication prescriptions (Dreyer, 2005). The next section further elaborates on the benefits of implementing CDSS applications in hospitals.

2.4.3.1. Advantages of implementing CDSS in hospitals

The primary benefit of CDSS in hospitals is the "clinical knowledge and patient-related information, intelligently filtered or presented at appropriate times, to enhance patient care" (Osheroff *et al.*, 2004). With this in mind many hospitals are in the process of, if not already have implemented, implementing CDSS in the hope of achieving improved quality of care, increased efficiency and reduction in administrative costs.

In the continuous pursuit of reducing medical errors in hospitals, the strategy should be that of determining what can be done to improve the systems rather than targeting the clinical stakeholders who provided the prescription (Osheroff *et al.*, 2004). CDSS are implemented at reducing the number of medical errors that most frequently occur when medication is ordered in hospitals. In addition, Dreyer (2005) noted that by implementing CDSS in hospitals, it empowers the clinical stakeholders in hospitals who regularly manage prescriptions and increases the quality of care in the following way:

- Reduction in medical errors and reduced incorrect prescriptions
- Superior administration of chronic conditions
- Improved patient care by personalizing each patients needs
- Improved clinical standards and practices
- Improved medical prescriptions and reduction in costs
- Improved knowledge by the clinical stakeholders on the medication they prescribe
- Enhanced communication between the different departments of the hospital
- Improved reporting and patient reminders.

"Unfortunately, the implementation of effective clinical decision support is a challenging task involving interactions between technologies and organizations, and there are no easy solutions to guarantee

success or to avoid failure in this complex process" (Wears & Berg, 2005). The adoption of CDSS within many hospitals like other information technologies available to the health care sector has been slow coming despite the given advantages they bring. The following section discusses some of the reasons for this situation and other disadvantages that come with CDSS in hospitals.

2.4.3.2. Disadvantages of implementing CDSS systems in hospitals

One disadvantage of the CDSS is that like the other technologies available in the health care sector they also bring with them a different set of medical errors. Moreover, incorrect suggestions input into the system have previously lead to erratic orders. In general, Wears and Berg, (2005) state that the more familiar clinical stakeholders become with CDSS, the greater likelihood of them cross checking that the diagnosis given is correct. This occurs very seldom which, as a result, could have a detrimental effect on patients in hospitals. This, therefore, emphasizes the need for CDSS to be thoroughly tested with regards to default settings and suggestions.

A problem with a CDSS implementation is that it requires a large amount of capital investment from the healthcare stakeholders and, more often than not, the return on investment is not seen immediately (Wears & Berg, 2005). More especially if the organization is financially not in a good position or is losing money such investments are very difficult to motivate. There exist a number of barriers to the adoption of CDSS in many hospitals and Dreyer (2005) summarises these barriers with the following points:

- CDSS usability and graphical interface
- Accessibility to patient information if the patient information is not currently stored electronically

- Lack of CDSS knowledge and available products in the market
- Knowledge of maintenance of CDSS
- Lack of CDSS industry standards
- Implementation and running costs of CDSS
- Return on investment: the benefits of CDSS implementations more often than not are not immediately reflected and sometimes can be difficult to recognize the benefit that the system has provided to the organization
- User acceptance of CDSS by key health stakeholders.

"In addition to the financial obstacles, implementing sophisticated new clinical information systems presents substantial organizational challenges owing to the impact on institutional culture and clinical workflow and the need to accommodate existing institutional systems used for billing, laboratory work, and pharmacy data" (Osheroff *et al.*, 2004). Other risks also include hardware costs and the reliability of the software. In particular, the reliability of a system such as CDSS is of the highest concern when compared to other systems such as systems used to capture data or print out information (Wears & Berg, 2005).

Dreyer (2005) notes that "various efforts to enhance prescription management through CDSS have been implemented and evaluated over the past few decades, but historically these efforts have been limited primarily to a small number of academic settings." This means that utilization of CDSS are still at its modest levels. Another clinical application that is also at its modest levels in the health care sector and more especially in hospitals is the use of hand held devices to assist with patient care (Dreyer, 2005). Hand held devices also have the potential to ensure that the quality of care is improved and sufficient

health care information is available in real-time to both health care providers and patients in hospitals (DeBeer & Williams, 2003). The next section elaborates more on handheld devices in hospitals.

2.4.4. Hand held devices in hospitals

Alloni *et al.,* (2006) in their study of the advantages of clinical information sharing using hand held devices mention that medical errors are common throughout hospitals and established that approximately 19% of the medication prescribed in the hospitals under study was incorrect. This inadequate administration of medication can be corrected by providing real time information using hand held devices by clinical stakeholders in hospitals at the point of care (DeBeer & Williams, 2003).

Hand held devices enable healthcare providers to be more productive as the wireless technology fits in with a clinician's workflow thus allowing them to access patient's data and order tests during the bedside consultations and examinations (DeBeer & Williams, 2003). With real time access health care providers can avoid duplications such as ordering duplicate tests and when health care providers place an order in the hospital using a handheld device they can immediately get a response back indicating if the prescription has adverse drug reactions and then send a notification indicating that the prescription is incorrect (Harris, 2001).

Many hospitals are currently faced with the challenge of not being able to provide a computer at each and every patient's bedside, however, the introduction of hand held devices at the patient's bedside would enable access to real time information at the point of care (Alloni *et al.,* 2006). The next section highlights many other advantages that hand held devices bring to hospitals.

2.4.4.1. Advantages of hand held devices in hospitals

Hand held devices have the advantage of being mobile and the clinical stakeholder can take it from patient to patient thus making it portable as well. Harris (2001), in his study of determining whether or not hand held devices are the future of health care states that a "host of applications exist for them, the best of which are as portable medical references and medical calculators and that with a handheld computer you can carry around the electronic versions of the Merck Manual, the PDR, and many more books, right in your pocket, neatly indexed and that medical calculators and algorithms are available for everything from coronary risk to medical clearance." Due to the advantages of hand held devices being transportable and easily accessible, these devices can be the means of looking up medical information, and providing complex algorithm calculations in the near future.

Having real time access to medical references and guidelines could possibly even reduce the number of incorrect medical errors and improve efficiency within the hospital which DeBeer and Williams (2003) elaborate on by stating that "information access may be most beneficial in areas without full-time critical care clinical stakeholders, particularly given the current imbalance between demand and supply with critical care clinical stakeholders, which is expected to worsen." Unlike larger computers, hand held computers by definition are small and portable and can therefore be used in different practice settings. Harris (2001) makes mention that these devices are fast becoming valuable practice tools in hospitals and it is important for hospitals to prepare themselves to embrace this technology as some of their advantages include:

- Reduction in medical errors
- Reduced incorrect medical prescriptions prescribed by health care stakeholders

- Improved quality of care due to clinical stakeholders having information they require at the point of care
- Enhanced interaction between health care provider and patient as both parties have information at the point of care
- Increased availability of information due to open standards and hand held devices being able to integrate easily with other systems.

Hand held devices in isolation should not be seen as the only component in enabling hospitals to improve efficiency, improve quality of care and reduce cost. Hand held devices should rather be seen as part of an information system within a paperless environment along with many other applications used to achieve the hospitals goals. In some instances, the needs of the hospitals may be different and other mediums such as desktop computers may be used to access patients' information instead of hand held devices. The next section elaborates more on some of the disadvantages that hand held devices have in hospitals.

2.4.4.2. Disadvantages of hand held devices in hospitals

Hand held computers are easy to use, but the familiarity, interest, and proficiency of clinical stakeholders with these and other technology devices vary widely (Alloni *et al.*, 2006). Most clinical stakeholders in hospitals are not likely to utilize all capabilities of a hand held computer without specific training (Harris, 2001). Another problem of hand held devices is that if it is going to be used to keep and access patient data then hospitals need to ensure that the confidentiality and privacy of this data is put in place. In order to achieve this, hospitals will have to put in place stricter security measures and policies and enhanced security technology in the case of someone losing one's hand held computer.

Universally, however, the adoption of hand held devices has not been substantial, given the potential benefits that it has and this could be due to a number of reasons ranging from lack of user acceptance to insufficient training provided to the health care clinical stakeholders using the hand held devices (McAlearney *et al.*, 2008). One way of mitigating the acceptance of hand held devices is to make the clinical stakeholders more aware of the benefits that these technologies bring to the hospital. Harris (2001) states that other barriers to the adoption of hand held devices in the health care sector can be mitigated by using technologies such as wireless connectivity, enhanced screen resolution and easier mechanisms to capture data. Before overcoming some of these barriers, Alloni *et al.,* (2006) additionally highlight the following as being common hand held device disadvantages:

- Physical constraints such as:
    - Physical factors which include bad vision and fingers too big for the buttons
    - Age; older generations are resistant to change
- Perceived ease of use of hand held devices
- Perceived usefulness of hand held devices
- Many of the older generation of clinical stakeholders still prefer paper when viewing or accessing patients information
- Desktop computers continue to be the medium for accessing patient information.

Currently, not all the functionality that a desktop computer has is provided by hand held devices, yet it can still be used to overcome some of the problems faced in many hospitals today. Such an example is that of vital patient information that can be accessed via hand held devices that previously could not have been accessed via Wi-Fi. “In the next three years, Wi-Fi will become more ubiquitous and the next

generation of applications will likely be web-based applications accessed in real-time via a portable device over a Wi-Fi network, offering users the same functionality currently provided by PCs on wired LANs." (McAlearney *et al.*, 2008).

Harris (2001) indicates that some of the barriers to hand held devices within the health care sector can be overcome by improved training and making clinical stakeholders in hospitals more aware of the potential benefits of handheld devices. McAlearney *et al.*, (2008) in their study of hand held devices in health care describe many ways that hand held devices can be used in hospitals to improve the quality of care but notes that "hand held devices are not the answer to everything." Similar to hand held devices another clinical application that holds a lot of promise for hospitals is Picture Archiving and Communication Systems (PACS).

2.4.5. Picture Archiving and Communication Systems (PACS) in hospitals

"The idea of a PACS is to convey images from all modalities to a digital archive with large capacity and to allow transmission of the single studies of images from the archive to mono- or multi-monitor referring workstations through a local area network" (Inchingolo, 2007). "PACS act both as medical image diagnostic viewer systems, enabling commenting, zooming, trimming and other image processing functions, such as storing and archiving systems" (Kim & Horii, 2007)

"Picture archiving and communication systems (PACS) have been widely introduced as a credible alternative to the traditional, film-based, radiological service and many hospitals introduce PACS and hospital information systems as an alternative to the film- and traditional, paper-based hospital system." (Wagner *et al.*, 2002). The advantage of PACS is the ability to view reports and images at any computer

connected to the PACS within the hospital. PACS also have the ability to customize the setting of the application thereby allowing the user to display a different format depending on the user's preferences, and has quick and easy navigation. "Film-less image management systems will become popular in all hospitals in the near feature and all staff in each hospital should investigate the merits and demerits of this system and how to introduce it effectively" (Kim & Horii, 2007). The next sections discuss both the merits and demerits of introducing PACS in hospitals.

2.4.5.1. Advantages of PACS in hospitals

PACS have become necessary for storing, printing, retrieving and reviewing in an efficient manner the high volumes of data extracted from imaging devices, i.e. modalities, such as Computed Tomography, Magnetic Resonance Imaging and Digital Radiography" (Kim & Horii, 2007). Other advantages of PACS is that is can also act as a system to view diagnostic images, provides an interface for users to input their comments, storing and archiving facilities, and provides enhanced image processing capabilities.

Within many hospitals, the radiology departments more than any other department require the ability to digitize and print film and PACS has the additional advantage of being able to integrate seamlessly with the faxes, scanners and copier machines. In certain cases the PACS will also be required to integrate with a hospital's information system and this can be easily achieved (Wagner *et al.,* 2002). The use of PACS in many hospitals can help overcome the tedious work that was previously required using the traditional film used to archive patients images. "The time required to find important images can be shortened dramatically, no images can go missing, and the production of educational materials is very easy" (Inchingolo, 2007). However, as with other clinical applications, PACS also have some barriers

and disadvantages that go with their implementations in hospitals. The next section discusses some of these disadvantages.

2.4.5.2. Disadvantages of PACS in hospitals

The introduction of PACS in hospitals was seen as the alternative to the film based service that is mostly produced in the radiology departments. However, the adoption of PACS in many hospitals has been very limited due to factors such as financial constraints, difficult implementations, and other technical challenges such as integrating with external systems (Inchingolo, 2007).

Other concerns include training, protecting patient confidentiality and system security and access. “The transition from film to digital technology is a challenging task that requires the knowledge of IT engineers and the experience of radiology department personnel to ensure successful implementation” (Wagner *et al.,* 2002). Another disadvantage mentioned by Inchingolo (2007) is the acceptance of PACS by the clinical stakeholders. The reason for this lack of acceptance can be attributed to the fact that the intended users of the system do not feel that PACS are easy to use or find it useful to them in conducting their daily activities. It is, therefore, important that the clinical stakeholders’ mindsets move away from the traditional thinking of the film based archiving in order to view PACS in light of its potential benefits. If PACS are not viewed in this light it will continue to be perceived as not useful.

The real novelties of clinical applications vary from application to application. There are many clinical applications available to hospitals but for the purpose of this study the researcher has limited the number of clinical applications to just five, namely; Electronic Medical Records (EMR), Computerized Provider Order Entry (CPOE) Clinical Decision Support Systems (CDSS), Picture Archiving and Communication

Systems (PACS) and hand held devices. These clinical applications are seen by many researchers such as Giversen (2002), Rosenfeld (2004), Mendelson (2004), Inchingolo (2007) and Harris (2001) to have the most promise to hospitals in terms of improving the quality of care, increasing efficiency and reducing cost. However, these clinical applications also have demerits ranging from resistance to change to IT and infrastructure costs. Also clinical stakeholders in hospitals need information and results as soon as possible and with the confidentiality and privacy of the patient's information still adhered to. A framework is, therefore, needed in order to make this achievable. This framework is also better known as e-Health.

2.5. e-Health

It is more evident today than ever before, for the health care sector to bring about change; in order to improve the quality of care, improve efficiency, and reduce costs (Maddox, 2005). The reasons for these changes in the health care industry have never been more evident than they are today, as they are well researched and reported on. These changes require both immediate action and a long term plan indicating the manner in which these changes will be brought about in order to create a better health information system (HIS).

An e-Health system can be seen as the mechanism used to achieve these goals. Khoto and Cabuko (2005), state that "because the Internet has created new opportunities and challenges to the traditional health care information technology industry, the use of a new term to address these issues seemed appropriate and, therefore, describe e-Health as the combined use of electronic communication and information technology for the health sector." In other words e-Health is the same as the business's equivalent of e-commerce.

An e-Health system is not a static environment like most other environments as it is constantly changing. Maddox (2005) notes that a commonly accepted definition for the term e-Health is: “it is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies.” “In a broader sense, the term characterizes not only a technical development but also a state of mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve healthcare locally, regionally and worldwide using information and communication technology” (Hospital e-Health Council, 2002). The definition of an e-Health system illustrates that an e-Health system can be characterized to apply to any system within the health care sector whilst still maintaining that an e-Health system is not only about medicine and the Internet. However, due to the nature of this study the researcher will limit e-Health to just how it can be used in hospitals in order to improve the quality of care, increase efficiency and reduce costs. The next section discusses the role e-Health has to play in hospitals.

2.5.1. e-Health in hospitals

An e-Health system offers hospitals the ability to understand the way they currently perform their activities and provides the clinical stakeholders with insights as to how they can continue conducting their tasks but in a more efficient and cost effective manner. In a nutshell, an e-Health system within a hospital environment can be described as the ability to use clinical technologies to conduct the daily activities of a clinical stakeholder in a hospital such as capturing, storing, and retrieval of data. “The purpose of e-Health in hospitals is to contribute to improving the health status of people through the optimal use of ICT. An e-Health system, therefore, opens up opportunities for new models of care across

the entire health continuum representing a shift in who does what, when, how, and with what information and tools" (Martineau, 2006).

The definition of e-Health indicates that an e-Health system can be considered as a system that enables common sharing of information across the organization. Mokgabudi (2006) notes that an e-Health system "represents opportunities for the current health system to be transformed by doing what it does now but in a different and more effective way." The Hospital e-Health Council (2002) state that the definition of e-Health is in essence integration and collaboration of information, "integration of information, integration of technology, and integration of care." The report by the Hospital e-Health Council (2002) also mentions that some of the inhibitors to the adoption of e-Health in many hospitals are:

- Insistence on the use of paper based information systems
- Lack of integration between the different clinical applications
- Lack of information sharing
- Lack of industry standards
- Corrupted data
- Insufficient financial backing for IT systems
- No co-ordination among the different provinces on e-Health.

The reasons for having non integrated and poor standards of information technologies implemented in hospitals are very questionable. This leads to poor quality of care and compromises the quality of care provided to the patient. This indicates that change is therefore needed in hospitals. Even though these changes require both immediate action and a long term plan indicating the manner in which these

changes will be brought about in order to create a better HIS is as important as the implementation itself. An e-Health system could be the enabler to ensure that health care; is sustainable, is of the highest quality, is easily accessible and that the costs are manageable. Khoto and Cabuko (2005) in their study of e-Health in a South African context, note that to complement a successful e-Health system the following electronic systems are essential:

- Health care delivery system
- Monitoring system
- Integration among the different health care institutions
- Knowledge based system
- Training for clinical stakeholders in hospitals
- System to conduct research.

Mokgabudi, (2006) states that "South Africa has initiated a number of ICT applications in the areas of surveillance systems, hospital information systems, pharmaceutical systems, human resource systems, telemedicine and district health information systems for purposes of monitoring the health sector, improving service delivery and allocating resources." However, there are a number of barriers that need to be overcome in order to achieve an effective e-Health system in hospitals. Mokgabudi (2006) in a study of the need for an effective e-Health policy in hospitals describes the challenges faced by South African hospitals in order to implement an e-Health system:

- Regulatory and legal issues due the confidentiality and privacy of patient information.
- Technical limitations which are sometimes brought about by the lack of user acceptance and lack of awareness of the benefits that the technical implementation brings to the hospital

- Uniformity of systems, as currently all the systems in different hospitals are disparate systems that do not communicate with each other and makes it difficult to integrate with each other
- Government backing; this is essential in order to adhere to a common policy among the different provinces and get government backing to ensure that other hospitals adapt accordingly
- Financial investment; a huge problem is the limited investment in IT among many hospitals because the return on investment is not immediate and is often difficult to measure. Also added to this fact is that e-Health systems are costly.

Even though these challenges seem daunting it has never been more evident than now that a need for e-Health in hospitals is needed. WHO (2007) in their study of e-Health for delivery of care illustrates the following areas that e-Health can have a role to play in:

- Improve access to health services and information by providing facilities such as Tele-health
- Enable clinical stakeholders to have access to patients information when and where it is needed and through a secure medium
- The ability to capture patients' information electronically using an EMR, which mitigates the tedious use of paper based records and requires less administrative work. The additional security, privacy and confidentiality aspect of EMR offer more than the traditional paper based record
- Health information can be made available over the Internet for patient use thus enabling patients to manage their health more efficiently
- Business processes with the organization can be automated and wireless technologies enable clinical stakeholders to view patients' information at the patients' bedsides
- Improved decision making due to informed and timely information available to the clinical stakeholders

- Making government and key health care stakeholders more accountable for the HIS.

The world today is rapidly becoming digitized and many of the clinical applications available to hospitals today only come in a digitalized format (Parente, 2003). The World Health Organization (WHO, 2007) states that due to this rapid digitalization, e-Health hold enormous benefit such as:

- Consumer empowerment achieved via customer centric modeling
- Using HIT to make better informed decisions and more efficient information sharing
- Convenient access to health care information and facilities such as Tele-health services
- Electronic records will reduce the incorrect duplication of patient records
- Improved learning and training of the clinical applications through long distance learning
- Making the data more presentable and readable to make accurate decisions
- Ensuring that health care stakeholders and governments are more accountable for the HIS.

The reality of achieving these goals through e-Health today unlike previous generations is a strong possibility. “The coordination required in bringing about the necessary process changes, investments, standards, and data required for successfully implementing and using those technologies is one of the key driving forces for a common e-Health strategy across providers” (Martineau, 2006). Therefore, e-Health is no longer a possibility but a reality for hospitals in developing countries. The challenge then that remains is to ensure that these changes are conducted in a timely and fashionable manner and ensure that this is done without compromising on the basic needs of clinical stakeholders in hospitals (WHO, 2007).

To ensure that clinical stakeholders make informed decisions they require data to be provided in the correct format, within a secure medium, at the point of care and with the necessary access. “Although the technology exists today to make an e-Health system work it has not been widely deployed, invested in, and integrated into the care and management process” (Martineau, 2006). “This will take coordination in planning across providers, investment, process changes, effective implementation, and a much higher level of integration and information sharing between providers” (Khoto & Cabuko, 2005). ICT appears to hold the key to meeting some of the challenges that face health care, especially in developing countries (Mokgabudi, 2006). Why then are ICT’s utilized to such a limited degree at hospitals?

2.6. Information technology barriers in hospitals

Amongst all the public institutions, the one that stands out as the most in need of improved information systems are hospitals. This is primarily due to the fact that they deal with people’s lives on a daily basis (Samaha, 2003). Technological advancements in the form of enterprise resource planning applications, electronic patient records and newly capable clinical applications have spurred many health care executives to use IT as an engine for institutional change” (Samaha, 2003). The problem, however, is that similar to many other industries, hospitals have also been plagued with IT projects that fail, IT implementations that do not meet up to stakeholder expectations and IT projects that do not get accepted by its intended audience thereby leading the project to failure (Samaha, 2003).

“ICT’s have the potential to make a major contribution to improving access and quality of services while containing costs. Improving health involves improving public health and medical programs designed to provide elective, emergency and long-term clinical care, educating people, improving nutrition and

hygiene, and providing more sanitary living conditions" (WHO, 2004). These changes ultimately lead to huge social changes and significant economic changes which most of the time these challenges exist outside of the health sector.

Even though there have been several advances in information technologies such as electronic medical records, use of hand held devices, automated business processes, clinical decision support systems and real time access to medical information, there will always exist barriers that prevent acceptance of these technologies (Columbus, 2002). Some of these barriers are, but not limited to, computer phobia, resistance to change, computer literacy, lack of industry standards and training, human and social barriers and the significant costs associated with IT implementations (Parente, 2003). Other barriers include the return on investment, which sometimes is not immediately reflected or sometimes difficult to measure and according to the research model the perceived usefulness and perceived ease of use of these technologies (Samaha, 2003). These barriers more often than not require clinical stakeholders in hospitals to change the manner in which they conduct their daily activities and the manner in which the organization as a whole operates (Mokgabudi, 2006).

2.6.1. Computer literacy and availability of computers

The rapid growth of electronic health care information has in recent years tremendously increased the availability of resources towards clinical stakeholders. However, there is a divide in those that have access to these technologies and those that do not, due to technology or financial constraints. "There are also issues arising concerning the correctness of the information available to the needs of health care professionals in developing countries" (Parente, 2003).

Computer literacy and availability of computers is often mentioned as a prerequisite for system usage, and Laerum *et al.* (2004) mentioned this as a possible reason for the low level of use amongst clinical stakeholders. Lium (2007) also included computer skills as a factor when trying to assess clinical applications use. In a study conducted by Van der Meijden *et al.* (2003) on IT barriers, they reported that clinical stakeholders in hospitals that were inexperienced at using computers favored more the paper based medical records whereas those more familiar with computers favored electronic medical records. Johnson (2001) found indications that the previous levels of self-confidence when using computers influenced the acceptance of the new technology to view, retrieve and edit documents. Computer skills seem to be a necessity but not a sufficient factor for IT use in hospitals, and that computers have to be available goes without saying. Also, as Davis *et al.* (1989) argue, that usage might be more related to perceived usefulness than perceived change of ease. Still, basic computer skills might be necessary to realize the usefulness.

Health care professionals need sufficient ICT skills in order to maximize the full benefits of information technologies available at the hospitals. “The amount of health care information being made available, together with the issues arising around how appropriate available information is to user needs, means that health care professionals need the necessary skills to search for the information that meets their requirements” (Parente, 2003). Therefore, providing the healthcare stakeholders with the necessary skills will enable them to become experts at the system and changing their perceptions that sees the technology as both useful and easy to use.

2.6.2. The flexibility of the paper based record

Another factor mentioned by Laerum *et al.* (2004) was the flexibility of the paper based medical record. Gattiker and Giversen (2002) also noted that another problem is that the paper based medical record exists in parallel with the EMR at most hospitals and health personnel could choose which medium to use. Paper based medical records also have some advantages compared to EMR. There is, for instance, faster to read text on paper than on a screen and the paper is easier to carry around. Partly because of this Gattiker and Giversen (2002) raised a question about whether today's EMR systems are too similar to the paper based records, because primarily the focus is on automating existing activities rather than innovating new ideas on the way things are done. This is sometimes justified in order not to deviate too much from the way the clinical stakeholders in hospitals currently conduct their activities. If the technology does tend to change the culture of the organization the more the chances are that the technology will not be accepted and hence fail. This is also reflected in other studies by researchers such as Parente (2003), Lawrence Van Horn (2003), Raghupathi (2000) and Adlington (2007) where EMR are described as good for information extracting but not so good for entering information.

2.6.3 Traditional work routines

The rapid evolution of information technologies in other industries including the health care industry has meant that clinical stakeholders will have to come out of their comfort zone and acquaint themselves with an environment that is not paper based but rather to an environment where systems integrate seamlessly and documents are electronically processed and patient information is made available where and when it is needed. More often than not the introduction of clinical applications will require that clinical stakeholders change the way they modify, create and retrieve patient information. "Given many institutions deep-rooted allegiance to existing clinical processes and practices, such a fundamental

overhaul is impossible unless clinical stakeholders, caregivers and other stakeholders are willing to change their mindsets" (Raghupathi (2000).

Laerum *et al.* (2004) in their study note that their results coincided with the traditional division of work at hospitals. Furthermore, Laerum *et al.* (2004) stated that none of the IT systems in the study had established a new or better way of working, but rather reinforced previous routines. A possible reason for this could be the document based way of structuring the EMR as suggested by Gattiker and Giversen (2002).

Another point worth mentioning here is that one of the reasons for establishing EMR systems with close proximity to the paper based record might have been an idea that a familiar structure would make the systems easier to use and in that way accelerates adoption (Miller & Sim, 2004). However, Gattiker and Giversen (2002) suggest that this approach highlights the advantages of the paper record more than the advantages of a computerized record, and Laerum *et al.* (2004) take this as a sign that a well functioning EMR system cannot be achieved by technology alone but has to be seen in conjunction with organizational aspects.

2.6.4 Introductory approach of clinical applications in hospitals

Whether a new technology is based on traditional routines or not it can be viewed in the manner in which it was introduced, and, therefore, discussed that for years there has been an underlying hope that technology alone can improve work practices (Laerum *et al.*, 2004). Organizational developments should not be something that has to be done after the technology is introduced, and as Berg (1995) argues technological and organizational factors have to be seen as interrelated. Berg (1995) also warns

about focusing too strongly on so called critical success or failure factors in the introduction of information systems. Insights can be valuable, but organizations are unique and solutions have to be adapted to the local context.

It might also be argued that the learning processes underlying these factors might be just as important as the factors themselves. Other factors mentioned as important in this stage are, for instance, involvement, communication throughout the organizations, and generally create an understanding of why the introduction is necessary (Berg, 1995).

In order to introduce the health information technology as efficiently as possible, IT companies and vendors will have to start ensuring that the technologies are much more user friendly and are able to retrieve the information required by the doctors and nurses in hospitals more quickly with few screens to navigate and few buttons to click. “In order to convince clinical stakeholders that information technologies will improve the quality of services delivered, companies must convince doctors that the use of computer-related technologies will have a positive, direct effect on patient care” (WITSA, 2006).

2.6.5 Relationships between management and staff in hospitals

An area often portrayed to be challenging when attempting to make hospital-wide changes that affect both administrative and clinical functions, is the relationship between managers and clinicians (Berg, 1995). Glouberman and Mintzberg (2001) describe health care to consist of four different worlds, or four mindsets, that is; cure, represented by physicians, care represented by nurses, control by administrators and community by trustees. Clinicians and managers are according to this framework separated both horizontally by clinical work and vertically by the degree of connection to the institution. In line with

this framework clinical stakeholders can be described as more committed to their specialized and professional skills than to the organization, whereas administrators have a higher degree of loyalty to the organization and the running of the hospital (Glouberman & Mintzberg, 2001).

2.6.6. Protection and privacy of patient data

The introduction of clinical applications in hospitals has been seen as the solution to reduce costs whilst at the same time improves efficiency and quality of care. One of the many applications is the EMR which has the capability of storing patient data electronically and, therefore, makes it easier to transport patient data (Laerum *et al.*, 2004). It also has many other advantages and disadvantages which were discussed earlier in this chapter. However, the confidentiality and integrity of the patient's data is at risk. This, therefore, enables the malicious use of such confidential information if it had to fall into the wrong hands or be stolen for malicious intent (Laerum *et al.*, 2004). To prevent this from happening IT companies and vendors will have to ensure that the highest level of security, privacy and protection of patient data is put in place.

"The protection of privacy and confidentiality interests will require IT companies and health care providers to work together to ensure that information will only be shared among authorized personnel directly associated with the delivery of patient services" (WITSA, 2006). Therefore, by protecting the security interests, patient's information if lost or stolen will still be safe due to the security measures such as username and login authentication of EMR, thus not allowing it to be modified, deleted or disseminated for malicious intent or unknowingly (WITSA, 2006). These can be easily achieved with technologies available today such as firewalls and role based access which enables certain clinical

stakeholders to have certain roles and responsibilities within the system which can be governed and audited accordingly.

2.6.7. Resistance to change

The introduction of clinical systems in hospitals are as previously mentioned thought to increase efficiency, improve the quality of care and reduce administrative cost; however, more often than not, that implies a change of the way things are performed (Samaha, 2003). Changes are not necessarily easy to achieve in any sector and in the health care sector with the potential life and death situations, changes might be particularly hard to achieve (Laerum *et al.,* 2004).

The question then that needs to be addressed is: Why is change within the health care sector so difficult to achieve? Samaha (2003) answers this question by stating that "in order to transform successfully, hospitals must coordinate technology and business efforts, overcome internal political and cultural resistance, and continue providing high-calibre patient care and that while most hospitals know what they want to achieve with IT-enabled transformation, they face problems in understanding how to carry out these initiatives which is a crucial distinction that can spell the difference between near-term success and outright hostility to any future efforts." Organizational culture is often mentioned in relation to change and is said to govern the organizations' members' perception of daily events and what meaning these events hold.

2.6.8. Organizational culture

Among the many other barriers already discussed that need to be overcome to ensure a successful adoption of HIT within the health care sector, there are also some social and cultural barriers which are

predominant in many failed IT implementations within the health care sector (Laerum et al., 2004). The implementation of health information systems generally changes the organizations way of conducting certain activities and takes time to adjust to those changes and become accustomed to them.

"Culture is a pattern of basic assumption, invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (Schein, 1985). The culture is, in other words, the glue that holds the organization together and separates it from its environment. The role of organizational culture has also started to receive attention in relation to health care management, and in a review of literature about culture and healthcare performance. Laerum et al., (2004) found that four of ten studies claimed to have uncovered supportive evidence that culture and performance were linked.

Further, Studer (2005) who performed a literature study about organizational factors and EMR introductions discovered that organizations that did not resist cultural change and those that valued new ways of effectively doing things, may have a greater likelihood of effectively implementing an EMR system. This is similar to Ingersoll *et al.* (2000) who state that "when change is seen as a positive characteristic of the environment, employees are more likely to commit to the work of the institution and that organizational readiness might be a more important indicator of the potential for redesign success than the environmental variables more commonly considered." Having noted that organizational change is important to hospitals when implementing IT systems it is also worth mentioning that there are some challenges to this change.

2.6.9. Challenge of change

Most challenges within the health care sector are not always technological limitations but rather human or cultural issues regarding the acceptance of the technology. “Even as new technologies come to market and hospitals show successful implementations, current practitioners are slow to change. Some studies estimate that only 5% to 10% of clinical stakeholders in individual practice use EMR and only 25% of clinical stakeholders in hospitals with computerized medication order entry systems used them” (Ingersoll *et al.,* 2000). In order to make sure IT implementations a success it is important to get the health care stakeholders involved in the project and make them understand the benefits that IT will bring to them. According to Studer (2005), most IT implementations fail due to lack of user acceptance. The technology companies and vendors must also take into consideration the user acceptance of the system and Laerum et al., (2004) note that “if too many barriers slow them down such as multiple passwords, timeouts, and slow logins, health care professionals will stop using the system.” Health care clinical stakeholders must be made aware of the benefits that the IT implementation will bring to them such as single sign on, improved graphical user interfaces, the accessibility of the data and the reliability of the system in order to ensure that the clinical stakeholders in the hospitals perceive the system as useful and easy to use thereby increasing the acceptance of the system by its intended audience.

2.6.10. Lack of industry standards

Another barrier to the successful adoption of HIT is the lack of industry standards and this leads to a lack of use and acceptance of many clinical technologies (WHO, 2004). “A standard is a clearly defined and agreed upon convention for the operation and behaviour of specific computing functions, formats, and processes. The majority of standards developed within the health care industry are classified into two basic categories; proprietary or consensus standards” (WITSA, 2006).

"Proprietary standards are standards that emerge after a single vendor acquires a large enough share of the market for a particular product while consensus standards, in comparison, are standards that are developed by committees including: payers, providers, employees, the medical community, and government officials" (WITSA, 2006).

In order to ensure that information is transportable and exchangeable from one system to another there has to be an open and understandable set of standards defined to ease the integration between the systems. Without this set of standards the integration of systems exchanging this information is not possible and manual intervention is required thereby eliminating the need for human intervention which is not achieved (WITSA, 2006). "In the past some have suggested that the sector's failure to organize a centralized industry group to promote the use of data standards is the primary reason that the industry has been slow to invest in emerging information technologies" (WHO, 2004). The rapid growth of the Internet in the future can be used to mitigate some of the issues arising from the lack of industry standards.

2.7. Moving towards paperless hospitals

Many hospitals throughout the world have attempted or are in the process of attempting the voyage to a paperless environment which is made possible by electronic medical records (EMR), fully integrated health information systems and other improved clinical technologies (Carr-Bains & de Lusignan, 2003). "Improvements in information flow technologies, supportive national and local policies, as well as a motivated practice can contribute to the successful integration of computers and subsequently move many hospitals forward towards becoming paperless" (Carr-Bains & de Lusignan, 2003).

However, the consensus among the health care communities is that hospitals have generally lacked in IT investments (WHO, 2004). In addition, the WHO (2004) also mentioned "that it is generally the limited and uncoordinated development of information technology (IT) within the hospital or the general practice that prevents or discourages doctors from migrating towards becoming completely paperless." However, Carr-Bains and de Lusignan (2003) in their study of moving hospitals towards being paperless mention the following important reasons as to why hospitals should move towards being paperless:

- Mitigate problems with transferring data from medical records
- Easier to query for patients information in an electronic format rather than a paper based format
- Reduced administration cost of manual paper work
- Improved efficiency
- The use of email and other electronic communication mediums reduce telephone expenses and faxes
- Enhanced security and confidentiality technologies for patient information.

2.7.1. Reasons for hospitals to pursue the paperless route

There are many different types of analysis that can be done to better understand the reasons for organizations to pursue the journey of becoming paperless. "For example, analysis of the preoperative risk assessment (PRA) form can illustrate how the practical use of documents by medical practitioners can often be fundamentally at odds with organizational aims and purposes" (Harper *et al.,* 2007). In addition to the reasons as to why hospitals should move towards being paperless, Carr-Bains and de Lusignan (2003) also mention the following benefits that hospitals can gain from moving towards being paperless:

- Cost reduction due to less storage space being required
- Access to information over a secured medium where and when it is required
- Improved graphical user interface which indicates all the required fields that need to be filled thus ensuring that all the information is completed, preventing incomplete patient information
- Electronic medical records (EMR) can be stored in one database, therefore, no need for additional or redundant filling of patient information
- The patient's electronic medical record and patient history is easily transportable from one hospital to another
- Patient information is always updated and accurate.

In 2004, the department of Informatics in Health and Social Care (KITH) in Norway published a report presenting some issues worth taking into consideration when making the transfer from paper based to electronic archives and outlined the following five strategies for scanning:

- No scanning; new paper documents are still stored in the paper based medical record, which are monitored by the EMR system. The usage of paper based medical records will decrease with time as more and more patient information is captured electronically
- Scanning of new paper documents; all new information in an electronic format. Paper based records available upon request
- Parts of the paper based records scanned; only parts of the record deemed relevant for later treatment are scanned
- Active records scanned; records are scanned when patients are admitted to the hospital, thereby avoiding scanning for patients who do not return.

2.7.2. Barriers hospitals need to overcome before becoming paperless

One of the major barriers that many hospitals face moving towards being paperless is the lack of investment (Lium, 2007). Another barrier highlighted in many studies is poor system designs (Harper *et al.*, 2007). Lack of financial investment and insight into the clinical stakeholders' requirements when it comes to the design of the system generally leads to clinical stakeholders resisting the technology and ultimately leads to the project failing. Carr-Bains and de Lusignan (2003) state that the following need to be taken into consideration before hospitals go paperless:

- Availability of computers to all the clinical stakeholders in the hospitals
- The security and confidentiality measures of patient information must be put in place
- Clinical stakeholders must be able to access their emails remotely using mobile devices and Internet connections from other places other than in the hospital
- Hospitals need to ensure the accessibility of patient information to clinical stakeholders when and where it is needed
- Convenient access to the Internet with acceptable download speeds so that clinical stakeholders in the hospital can quickly look up medical information or to read medical journals.

The existence of parallel, paper-based and electronic solutions has also been regarded as a major barrier to extensive EMR usage. However, Gattiker and Giversen (2002) note that many hospitals are heading towards removing their paper based medical records from their clinical workflow. Although the focus in this study is the perceptions and preparedness of clinical stakeholders to utilize a paperless environment it should be noted that there are several challenges in the process before the paper is removed.

The EMR should, for instance, be approved as the legal record, and there are also strict demands regarding system availability and the security of patient data (Gattiker & Giversen, 2002). In short, the hospital has to convince national government that their way of removing the paper-based record is safe in terms of information preservation and information availability. Harper *et al.*, (2007) state the following as disadvantages of moving towards paperless hospitals:

- Paper based medical records have the advantage of being flexible as opposed to electronic medical records
- Sometimes the electronic systems are not structured and are not integrated
- Data is required to be input via a keyboard and sometimes writing down something is faster
- Some of the graphical user interfaces are at times difficult to navigate and become cumbersome to use.

2.8. Conclusion

The improvements of health information technologies (HIT) available today indicate that they are able to improve the current conditions that hospitals find themselves in today. “Information technology can help ensure that health-related information and services are available when they are required and permits clinical stakeholders to access patient information wherever it may be located, and help researchers better understand the human body, share information, and ultimately develop more beneficial treatments to keep patients healthy” (Aldington, 2007).

“The rewards from successful service delivery to citizens of the developing world are potentially huge. In South Africa alone, millions of citizens stand to gain access to facilities which are currently either impossible or highly inconvenient for them to use because they are currently not accessible to them”

(Khoto & Cabuko, 2005). However, there exist several barriers to the successful adoption of these technologies ranging from the acceptance of the information technology to a lack of current industry standards.

While IT has the potential to deliver high quality care at lower costs, health care delivery organizations face several challenges. These challenges include the complexity of the health care process, the high cost of implementation and limited availability of such resources as time and money. “Although some barriers exist that may be challenging to overcome, other barriers, such as the lack of knowledge about the uses of IT, are imminently solvable and efforts to overcome these barriers should begin in earnest and should include educating stakeholders in the care of children and adolescents, as well as improving the knowledge about various technologies available” (WITSA, 2006).

Chapter 2 presented literature on ICT tools in hospitals and more especially the effect these tools can have on service delivery together with some of the barriers that these tools have when being implemented in hospitals. The literature focused on the problem statement and looked to answer the questions which were set out in this study. The literature focused on the perceptions and preparedness of clinical stakeholders in a paperless environment and lessons that can be acquired for other organizations that want to pursue the paperless route. The following chapter discusses the research methodology used for this study.

Chapter Three

Research Methodology

3.1. Introduction

The following chapter will elaborate on the research methodology used in this study, which consists of the literature search, the questionnaire used in the study, the sampling method and the research population. The purpose of this chapter is to provide the scientific basis for the research, which has been conducted. This chapter also explains the reasons for using the various sampling techniques and will explain the benefits and the disadvantages of these techniques. “The research methodology outlines and explains the relationship between the research problem, the literature review, the data collection method, the instrument and the analysis of the research” (Leedy & Ormrod, 2005).

This chapter will describe the construction of the tool and the reasons for choosing the specific tool. Finally, the chapter will elaborate on the insight behind the questions posed in the questionnaire and the types of questions used in the questionnaire.

3.2. Literature search

The aim of this study is to measure the perception and preparedness of stakeholders at hospitals to utilize a paperless environment. In so doing, the researcher will attempt to determine whether or not hospitals in the eThekwini region are ready to become paperless and elaborate on some of the obstacles that need to be overcome in order to achieve the goal of becoming a paperless hospital. Better data and knowledge about the perceptions and the level of preparedness of clinical stakeholders to utilize a paperless

environment will empower future organizations on the benefits that can be achieved of pursuing the paperless route and the obstacles that need to be overcome in order to achieve this.

The literature review is an important part of any research in the field of information systems. According to Leedy (1993) “the literature review shows the researcher what has been done in relation to the problem that the researcher is investigating.” This will help ensure that the researcher tries to solve or investigate a problem that has not been solved by another researcher. “It also brings about important understandings and insights necessary for the development of a logical framework” (Gay, 1976).

Many hospitals and health systems have embarked on the challenging journey of IT adoption. “However, even though considerable achievements have been made in the spread of IT in the health care service, widespread use of clinical systems has not yet been achieved and the reasons for this lack of use are not clear, and may vary from site to site, but some possible explanations exist” (Glaser, 2002). This has meant that hospitals that have begun the journey towards being paperless around the world are limited and those that are fully paperless are few and far between. In the southern hemisphere, there is only one fully paperless hospital which is the King Albert Luthuli hospital situated in the eThekwini municipality in Durban. This has meant that extensive search of local and international literature was required. Information acquired from this literature can be broken onto the following sections:

- ICT tools in the health care sector
- Adoption of IT within the health care sector
- Electronic Medical Records (EMR)
- IT barriers
- Technologies acceptance theories and models

- The technology acceptance model (TAM)
- Technology perceptions of health care professionals.

In searching for articles the researcher employed the following terms: paperless hospitals, Information Technology barriers, Information Technology in health care, clinical applications, TAM, Health Information Technology (HIT) acceptance and e-Health. More than 150 articles indexed on those terms were identified on ISworld, Google and Google Scholar. The literature search was done with the objective of trying to focus on the problem statement of the study. The next section discusses the objectives of the study.

3.3. Research questions

The literature review is done with the objective of trying to focus on the problem statement of the study and gather the required information to answer the research questions set out in the study. The main question of the study is whether or not clinical stakeholders will use HIT in a paperless environment. The sub questions of the study that will be addressed are therefore:

3.3.1. How does the perceived compatibility of HIT in a paperless environment affect the perceived usefulness of HIT by clinical stakeholders?

Moving towards a paperless environment would more often than not bring about a change in the way clinical stakeholders conduct their daily activities. Many of the older generation of clinical stakeholders become accustomed to performing certain activities such as writing prescriptions, storing and retrieving patient data and analysing results. Many system implementations have failed primarily because they have not taken into consideration the existing work routines and compatibilities. Therefore,

understanding the effect that the perceived compatibility has on the perceived usefulness of HIT will assist in ensuring that existing compatibilities are taken into consideration by IT companies when performing system implementations. Miller and Sim (2004) further elaborate on this by mentioning that one of the reasons for implementing information systems with close proximity to the traditional systems and structure is to ensure that the systems are perceived as easier to use and will accelerate the adoption and system usage.

3.3.2. How does the perceived threat of HIT in a paperless environment affect the clinical stakeholders' resistance towards using HIT?

While IT in other sectors continues to rapidly evolve and transform, it is extremely important to understand the reason clinical stakeholders feel threatened by the introduction of information technology. Parente (2003) indicates that a number of factors can be attributed as to why clinical stakeholders feel threatened by HIT and these factors range from computer phobia, lack of training and understanding of HIT to job security. Understanding the relative, perceived threat of HIT by clinical stakeholders has on resistance to change will assist other organizations in understanding these intricacies and put in place measures to ensure that the clinical stakeholders do not feel threatened by HIT.

3.3.3. How does the related knowledge of HIT in a paperless environment affect the perceived usefulness of HIT by clinical stakeholders?

In this context, related knowledge can be recognized as the familiarity the clinical stakeholder has with the HIT. The more familiar a user is with a system the more accustomed the user becomes with the system. In understanding the relationship that related knowledge has on the clinical stakeholders perceived usefulness of HIT, organizations can put in measures such as training, online learning and

support measures to ensure that the HIT is used by the clinical stakeholders in a paperless environment. Bhattacherjee and Hikmet (2007) also note that having familiarity and knowledge of computer based tools, in general, could improve the users' attitude towards a certain HIT.

3.3.4. What effect does the resistance of HIT by clinical stakeholders have on the perceived usefulness and perceived ease of use of HIT in a paperless environment?

There are many reasons why clinical stakeholders resist HIT such as computer literacy and training, flexibility of paper, organizational culture and the high cost of HIT implementations. However, understanding the effect resistance to change has on perceived usefulness and perceived ease of use of HIT has broader ramifications (Bhattacherjee & Hikmet, 2007). For example, occasional system failure could be generalized to the entire HIT implementation and perceived as not useful or not easy to use when this could have been the exception more than the norm and the rest of the system is functioning optimally (Columbus, 2002). Not understanding the functionality or capability of the HIT, can contribute to the clinical stakeholders deeming the HIT as not useful. Understanding the effect the resistance to change has can, therefore, provide the clinical stakeholders with the necessary skills that will enable them to become experts of the system and perceive the technology as both useful and easy to use (Parente, 2003).

3.3.5. What are some of the resistance barriers to the lack of HIT usage within the health care sector?

Even though there have been several advances in information technologies such as electronic medical records, use of hand held devices, automated business processes clinical decision support systems and real time access to medical information, there will always exist some or the other barrier that prevent

acceptance of these technologies (Parente, 2003). Understanding these barriers will help better prepare future organizations that want to pursue the journey towards becoming a paperless environment by ensuring they put in measures to overcome these barriers.

3.3.6. How do the clinical stakeholders perceive the usefulness and ease of use of working in a paperless environment?

Perceived usefulness suggests that clinical stakeholders will want to use the system because it will be of some benefit to them while perceived ease of use suggests that achieving the same result as before with less effort than the system is deemed as easy to use (Bhattacherjee & Hikmet, 2007). Therefore, if the clinical stakeholders do not see some benefit from the HIT or the HIT requires more effort from the clinical stakeholders than they previously had to use, then the HIT is deemed as not easy to use and not useful thus contributing to a lack of acceptance of the HIT (Bhattacherjee & Hikmet, 2007). "Insufficient user acceptance has long been an obstacle to the successful adoption of new information systems and information technologies within the health care sector" (Legris *et al.*, 2001). Therefore, it is important to ensure measures are put in place to illustrate to the clinical stakeholders the benefit and reduced effort required to use the HIT.

3.3.7. What is the level of computer literacy and training required by health care professionals in a paperless environment?

The ability to be able to possess basic computer literacy skills will soon become as important as it is to read and write. With the world rapidly becoming digitalised and the health care sector looking towards IT to resolve its demand and supply gap the ability for clinical stakeholders to be computer literate is becoming more of a necessity rather than a luxury. A paperless environment would require clinical

application to seamless integrate with each other and be IT driven, therefore, requiring the users at a minimum to be computer literate and to be trained on the system. Laerum et al., (2004), note that the prerequisite for HIT usage is often computer literacy and the availability of computers. However, if these measures are not put in place it tends to lead towards a low level of HIT usage by clinical stakeholders.

This study will attempt to answer the questions described above and in doing so measure the perception and preparedness of the stakeholders at a hospital within the eThekwini municipality to utilize a paperless environment. This would also determine whether or not these technologies, which will be used in a paperless environment, will actually improve health care access and effectiveness and offer better health care services to the patients. The literature review, therefore, begins with the technology acceptance or lack thereof within the health care sector.

3.4. Study objectives

The objective of the study is to investigate the clinical applications that can be utilized in the health care sector that would help evolve hospitals into becoming paperless and thereby investigating the perception and preparedness of stakeholders at hospitals within the eThekwini municipality to utilize a paperless environment. This would, thereby, provide theoretical strategies and guidance aimed at preparing future hospitals that are looking to become paperless.

3.5. Quantitative vs. qualitative approaches

As part of the research design, the researcher is required to evaluate whether the study will be that of a quantitative or qualitative nature. This would assist the researcher to focus on determining the kind of evidence that is required to address the objectives of the study.

Quantitative information refers to research information that is presented in the form of numbers and figures and is used to answer questions about relationships among measured variables, in order to develop generalisations that contribute to a theory and the data is usually collected from large samples, in a form that can be converted to numerical indices and the data can be collected in a short period of time (Leedy & Ormond, 2005). A qualitative study usually means that the data is collected from a small sample population and the collection is time consuming and the information is typically used to answer questions about a complex situation, with the purpose of providing an in-depth and holistic analysis of a particular context from the point of view of the research participants (Leedy & Ormond, 2005). The researcher uses the research model created by Bhattacherjee and Hikmet (2007) to determine the perception and preparedness of clinical stakeholders to utilize a paperless environment which therefore leads to the study being one that is quantitative in nature.

3.6. Sampling technique

A sample is a subset of a population being investigated. Trochim (2002) defines sampling as “the process of selecting units from a population of interest so that by studying the sample and understanding the properties of the characteristics of the sample subjects, the properties may be generalized to the population elements.” There are two distinct types of sampling design; probability and non-probability sampling. In probability sampling, every element in the population has a chance of being selected as a

sample subject. In non-probability sampling, the different elements do not have a known or pre-determined chance of being selected. According to Trochim (2002) “the difference between non-probability and probability sampling is that non-probability sampling does not involve random selection and probability sampling does.”

3.6.1. Sample design

The technique that will be used in this study is census sampling. Census sampling means that the researcher will gather information from each and every person of interest in the population. For the study the researcher targeted each and every nurse and doctor within the chosen hospital to ensure a complete census study was conducted. The researcher attempted to target clinician stakeholders in all hospitals (private and public) within the eThekwini municipality but only one private hospital granted permission for this research. The reasons cited by other hospitals for not participating was confidentiality. Since only a single hospital was used and the researcher wanted as many respondents as possible to help answer the research questions, census sampling was chosen. Therefore it will be difficult to extrapolate the findings across the entire Ethekwini municipality.

The reason for choosing the clinical stakeholders, which consists of doctors and nurses, as participants is the fact that a high number of these participants work with clinical applications at the hospital on a daily basis, and use these clinical applications in order to deliver comprehensive health care to the patients. In using this population of participants the researcher will attempt to investigate whether the clinical applications used by the population chosen has a positive or negative effect in service delivery at this hospital. A letter explaining the purpose of this study was made available to the hospital. In total, there

will be 300 questionnaires handed out to the respective clinical stakeholders to complete and it was decided that this group would constitute the sample.

3.6.2. Sample size

The sample consisted of one hundred (n=100) doctors two hundred (n=200) nurses making up a total of three hundred (n=300) clinical stakeholders who were invited to participate. According to the total sample size of the study, 300 questionnaires were distributed and a total of one hundred and two (n=102) were successfully answered, meaning the study achieved a 34% successful response rate.

3.6.3. Geographical location

The researcher targeted hospitals within the eThekwini municipality for the study. The reason for choosing hospitals within the eThekwini municipality was due to the researcher's accessibility to participants within those hospitals.

3.6.4. Ethical clearance

In order to use the hospital that agreed to partake in the study, ethical clearance was required from the University of KwaZulu-Natal Management Studies Research Committee. The approved ethical clearance form (Appendix B). The clinical stakeholders that participated in the study were given a consent document (Appendix C), which informed the participants about the study and their rights as participants. After reading the consent document the participants that agreed to undertake the study were requested to sign the 2nd page of the consent form (Appendix D), and return it to the researcher. Once the consent document was signed the participants were then given the questionnaire (Appendix E). Once the questionnaires were completed the nursing clerk collected all of them from the participants and handed them over to the researcher. The participants were assured that their responses would be kept

anonymous and confidential and the responses collected from the nursing clerk were all put into an envelope.

3.7. Data collection methods

After choosing a sample technique together with a sample population the next thing to do is to select a method to collect data. Data can be collected in a number of different ways and from different sources. There are different collection methods which include personal interviews and telephonic interviews. In addition, researchers also utilize several survey techniques which include mail surveys, e-mail surveys, web surveys and questionnaires. The following section elaborates more on questionnaires and further discusses the reasons behind choosing the questionnaire as the primary data collection method.

3.7.1. Survey methods

Surveys are one method of data collection, which can be done quickly in order to gain insight into the population's needs and tastes. The advantage of a survey is that it enables the researcher to collect data from either a large or small population. "Different types of surveys are actually composed of several research techniques, developed by a variety of disciplines" Trochim (2002) cited in Leedy & Ormrod, (2005) notes that in order to select a survey instrument there are several factors to consider including:

- Reliability
- Validity
- Freedom from bias
- Cost
- Political consequences
- Duration.

3.7.2. Questionnaires

"A questionnaire is a pre-formulated written set of questions to which respondents record their answers, usually within rather closely defined alternatives" (Leedy & Ormrod, 2005). A group of respondents are chosen to respond to the questions posed in the questionnaire. Questionnaires, as compared to interviews, are much more convenient and efficient. Creating a well documented questionnaire is sometimes more difficult than it appears. Careful consideration has to be taken to consider the type, content, wording, and order of the questions that they include.

3.7.2.1. Advantages of questionnaires

The data collected from the closed ended questions in the questionnaire are easy to analyze with software such as SPSS and Microsoft Excel. Capturing and entering the data to analyze and produce graphs can be done with many software programs available. Another important advantage is that questionnaires reduce bias (Leedy & Ormrod, 2005). They also note that there is uniform question presentation and no middleman bias. The researchers own opinions will not influence the respondent to answer questions in a particular manner. There are no verbal or visual clues to influence the respondent (Leedy & Ormrod, 2005). Questionnaires are also less intrusive as compared to telephone or personal interviews. With a questionnaire the respondent is allowed to complete the questionnaire in his own free time. Unlike other research methods, this research instrument does not interrupt the respondent. Questionnaires also help the researcher know precisely what information is needed (Leedy & Ormrod, 2005).

3.7.2.2. Disadvantages of questionnaires

"One significant disadvantage of questionnaires is the low response rate that a researcher could possibly encounter (Leedy & Ormrod, 2005). Having a low response rate is not ideal for successful statistical analysis. It could lower the researcher's confidence in the results. Questionnaires also offer very little flexibility when it comes to the responses of the instrument. However, by allowing space for comments the researcher would be able to gain important information that would have been otherwise lost, thereby overcoming this disadvantage (Leedy & Ormrod, 2005).

3.8. Data collection tool to be used

The tool, which will be used, is a questionnaire. Once the data has been collected, the information can be coded easily. The implications of this would mean that the researcher could compile the results quickly and also form quick conclusions from the results. The questions asked will be closed ended thus enabling the researcher to use Likert scales to easily analyze the data using SPSS 17.0 for windows. With a questionnaire, respondents need not feel threatened or reluctant to answer as compared to a personal interview.

3.9. Construction of the questionnaire

When constructing the questionnaire, there are various factors which need to be taken into consideration. Leedy and Ormrod (2005) state that by following guidelines for developing a questionnaire it will encourage participants to be co-operative and yield responses that the researcher can use and interpret these include:

- Keep it short
- Use simple, clear, unambiguous language

- Check for unwarranted assumptions implicit in your questions
- Word your questions in ways that do not give clues about desirable results
- Provide clear instructions
- Give a rationale for any items whose purpose may be unclear
- Scrutinize the almost final product carefully to make sure it addresses your needs.

3.9.1. Types of questions

There exist two types of questions that can be posed in a questionnaire, open and closed ended questions. Closed ended questions ask the respondents to make choices amongst a set number of alternatives. Open ended questions allow respondents to answer questions in a way in which they wish. The researcher for the purposes of this study used closed ended questions.

3.9.2. Sequence of questions

The sequence of questions should be structured in such way that it flows from the general to the specific. This is the approach taken by the researcher in the construction of the questionnaire. This approach will facilitate the smooth flow of the respondents' progress through the questionnaire. The questionnaire followed a sequential pattern by starting off with a personal details section and then going on to ask questions about the users' computer knowledge before diving into the perception and preparedness questions relating to clinical applications within a paperless hospital.

3.9.3. Form of the questions

The questions used in the questionnaire were closed ended questions only and structured accordingly. The wording of questions can either be positive or negative. Therefore, considerable attention was given by the researcher to ensure that when developing the questions for the questionnaire that all of the questions were simple, clear, and unambiguous. All of the questions were one directional and reverse coding was mitigated by using SPSS 17.0 for Windows in ensuring the correct scoring was used for each section of the questionnaire. Leedy and Ormrod (2005) state that the questionnaire should not include the following types of questions:

- Double barreled questions
- Ambiguous questions
- Recall dependant questions
- Leading questions
- Loaded questions.

3.10. Administration of the tool

The questionnaire was administered to the sample chosen at the hospital within the eThekwini municipality. The administration and distribution of the questionnaire in the hospital was done only by the nursing clerk. This was due to the fact that the researcher was not given permission to directly interact with the clinical stakeholders at the hospital.

3.11. Layout of the questionnaire

The layout of a questionnaire is very important. The questionnaire should be divided into different sections, with each section serving its own relevant purpose. In addition, questions under each section

should be relevant to that section and should be within the scope of the study. This would ensure that the questionnaire is easily readable and does not confuse the respondent. Leedy (2003) alludes to the fact that questionnaires are designed to fulfill a specific objective. The questionnaire used for this study is no different. The questionnaire is designed to fulfill the objectives of this study, which were discussed in section 3.3.

The questions used in the questionnaire were fairly simple. The researcher designed the questions with the assumption that the sample chosen would fill in the questionnaire without any difficulty. The questionnaire consisted of 8 pages, 10 sections and comprised of 68 closed ended questions. Below is an overview of the questionnaire used for this study, based on the research objectives.

Section A: General information

The first three questions in this section were based on the individuals' gender, race, and age group. The rest of the questions in this section were used to determine whether or not the respondent was working at the hospital and if the respondent regularly worked with patients at the hospital. These questions also highlighted the clinical position of the respondent at the hospital.

Section B: Experience with computers

The set of questions in this section were used to determine whether or not the respondents were computer literate. Some of the questions were also used to determine if the respondent had a computer at home and whether or not the respondent had been given any formal training to not only use the computer for personal use but also training on the clinical applications that the respondents themselves used on a daily basis.

Section C: Use of clinical applications in the hospital

The focus of this section was the regularity with which the respondents used clinical applications in order to treat patients and also perform ad hoc activities at the hospital. This section compromised of eleven questions and all the questions had five possible answers to choose from. This would also give the researcher an indication of the number of activities that are performed using via computers at the hospital and whether or not the respondents are comfortable using computers for these activities.

Section D: Systems evaluation of the clinical applications in the hospital

In this section the researcher attempted to obtain opinions regarding accuracy and precision of the clinical applications at the hospital. The researcher also investigated whether the clinical applications used at the hospital provided clear information, in a readable format and whether or not the clinical applications are user friendly. This section consists of only five questions with five possible solutions ranging from never to always.

Section E: Related computer knowledge and skills

This section was used to determine the availability of computers in not only the hospital but also in the wards the respondents worked in and the related computer knowledge of the target population. This would provide a clearer indication of the frequency that the respondents worked with computers and the level of computer skills of the clinical stakeholders in the hospital.

Section F: Perceived threat of computerized clinical applications in a paperless environment

In order to measure the perceived threat posed by HIT to the clinical stakeholders, section F included questions relating to the threats the clinicians felt that a HIT implementation would bring. A five point

Likert scale was used with responses ranging from Strongly Disagree or Disagree, to Agree or Strongly Agree and if the respondent felt neither of the options applied then they could choose neutral.

Section G: Resistance to change in a paperless environment

In order to measure the resistance towards HIT by the clinical stakeholders, section G in the survey handed to the clinical stakeholders included questions relating to the resistance of a paperless environment replacing the current paper oriented hospitals. A five point Likert scale was used with responses ranging from Strongly Disagree or Disagree, to Agree or Strongly Agree and if the respondent felt neither of the options applied then they could choose neutral.

Section H: Satisfaction evaluation of the clinical applications in the hospital

There were five questions in this section all of which were used to measure the respondents' satisfaction of the clinical applications at the hospital. In addition, the researcher posed the questions to determine whether applications had improved the departments' quality and the quality of the respondents' personal work. The respondents had five possible solutions to choose from; however, these solutions range from strongly disagree to strongly agree.

3.12. Data handling

The questionnaire provides the most efficient means to get the necessary responses. Therefore, the researcher will use SPSS 17.0 for Windows to compare, correlate, covariance, t-Test, ANOVA and verify the data collected from the questionnaire. The results will be depicted in Tables and graphs in Chapter Four.

3.12.1. Factor analysis

Factor analysis is a way of reducing the data collected to be able to efficiently analyze the data across a sample population. There are two types of factor analysis; exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). “CFA is a multivariate statistical procedure that is used to test how well the measured variables represent the number of constructs while, in EFA, data is simply explored and provides information about the numbers of factors required to represent the data” DeCoster (1998). “In exploratory factor analysis, all measured variables are related to every latent variable but in CFA researchers can specify the number of factors required in the data and which measured variable is related to which latent variable” DeCoster (1998). Confirmatory factor analysis is the statistical method used in the study to determine whether or not to accept or reject the measurement theory.

The factor analysis in this study will be conducted using the Partial Least Squares (PLS) technique. Cooper (2001) notes that “the advantages of PLS includes the ability to model multiple dependents as well as multiple independents; ability to handle multi-colinearity among the independents; robustness in the face of data noise and missing data; and creating independent latents directly on the basis of cross products involving the response variable(s), making for stronger predictions while the disadvantages of PLS include greater difficulty of interpreting the loadings of the independent latent variables (which are based on cross product relations with the response variables, not based as in common factor analysis on covariance’s among the manifest independents) and because the distributional properties of estimates are not known, the researcher cannot assess significance except through bootstrap induction.” This unique mix of PLS, therefore, makes it a leading predictive technique rather than an interpretive technique and hence will be used to predict the intention to use HIT by stakeholders in a paperless environment. The R^2 and coefficient paths analyzed using PLS will then be verified and tested against the research model

used in the study to determine the perception and preparedness of stakeholders to utilize a paperless environment in hospitals.

3.12.2. Cronbach's coefficient alpha

Cronbach's coefficient alpha test will be used to determine the reliability of the measurement instrument. Cronbach's coefficient alpha test is a "reliability technique that requires only a single test administration to provide a unique estimate of the reliability for a given test" (Garson, 1998). The Cronbach's coefficient alpha normally ranges between 0 and 1 and the closer the alpha is to 1 the greater the reliability is of the questionnaire.

3.13. Pilot study

A pilot study was conducted to determine the feasibility of the study using a hospital within the eThekwini municipality. In addition, to determine the feasibility of the study the pilot study was also used as a mechanism to reduce the amount of source errors on the questionnaire hence improving the validity of the questionnaire. The preliminary questionnaire was handed out to ten clinical stakeholders (5 nurses and 5 doctors). In addition to determining the feasibility of the study, the following was the feedback asked to be provided on the questionnaire by the clinical stakeholders:

- Which questions were ambiguous?
- Which questions did you not understand?
- Which questions could you not answer?
- How long did it take you to complete the questionnaire?
- Was the layout of the questionnaire correct?

The results of the questionnaire were then reviewed and the questionnaire was adjusted accordingly.

The pilot study also indicated that the clinical stakeholders at the hospital used health information systems to conduct certain activities but a number of activities continued to be done manually and patient medical records were paper based. The clinical stakeholders were divided in terms of pursue the journey towards becoming a paperless hospital. Some of the reasons for the unwillingness of clinical stakeholders to pursue this journey towards becoming a paperless hospital can be attributed to a lack of basic computer skills, job security after the implementation of a health information system, change in organizational culture, and the privacy, protection and integrity concerns surrounding medical and patient information. However, all of the clinical stakeholders were in agreement that information technology within the health care sector had the potential to alleviate the current medical problems that hospitals faced; increased efficiency, improved patient care, improved business processes and reduced administrative costs.

3.14. Conclusion

Chapter three of this study described the research methodology used in this study. The research method that was chosen was reviewed in detail and discussed. The collection method and tool were also discussed together with research questions and how they were administered and discussed. The sampling technique used was also discussed together with the sample population chosen. Finally, the layout of the questionnaire was discussed in detail together with the data handling technique which elaborated on how the data collected from the questionnaire would be used. The next chapter presents the data collected using the questionnaire. In addition, the relevancy of the findings will be discussed and used to determine whether or not the objective of the study was reached.

Chapter Four

Presentation of Results

4.1. Introduction

This chapter deals with the analysis and presentation of the data collected. The data was collected using a questionnaire. One of the leading inhibitors towards the adoption of HIT with many hospitals is user acceptance. While IT in the health sector continues to rapidly evolve and transform it is also vital to have an insight into users' acceptance and perceptions towards the technologies that they will be faced with on a daily basis. The analysis of results from this study will go a long way towards establishing the actual reasons behind the lack of user acceptance in the rapidly evolving IT industry and more predominantly within the health care sector within the eThekwini region.

This chapter will compare, correlate and contrast the data collected from the questionnaire using SPSS 17.0 by performing statistical analyses such as t-Tests, analysis of variance tests, factor analysis and partial least square tests. The reviewed literature will support the methods used for the correlative assessment of the data collected. Finally, the researcher will explain the relevancy of the findings.

4.2. Demographics

A total of three hundred (n=300) questionnaires were distributed to one hospital in the eThekwini municipality. From the 300 questionnaires that were distributed a total of one hundred and two (n=102) were successfully answered, meaning the study achieved a 34% successful response. Of the 102 clinical stakeholders that answered the questionnaires 31.37% of the respondents were aged between 30 to 39

years old and 24.51% were aged between 20 and 29 years old. The majority of the respondents worked at the hospital on a full time basis. Figure 4.1 depicts the distribution of the race of the respondents.

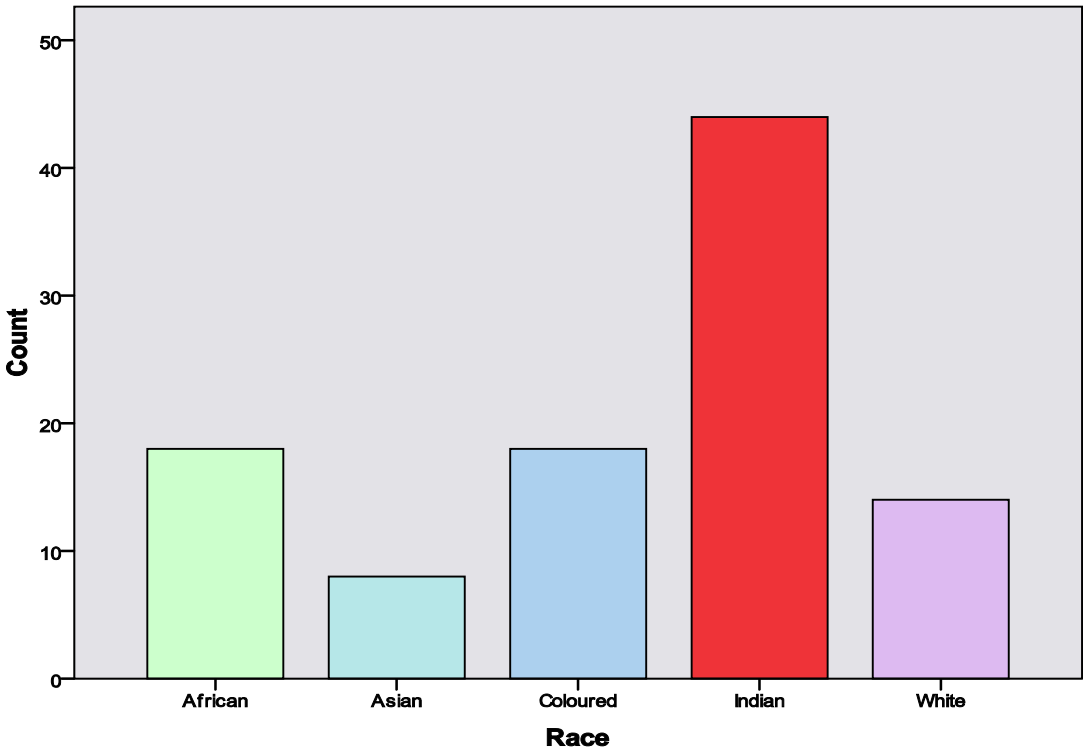

Figure 4.1: Respondents race

Of the 102 respondents, 43% of the respondents were Indian and 17% were African. The remaining 40% of the respondents were made up of Whites, Coloureds and Asians. Figure 4.2 indicates the distribution of the nurses and doctors that undertook the study.

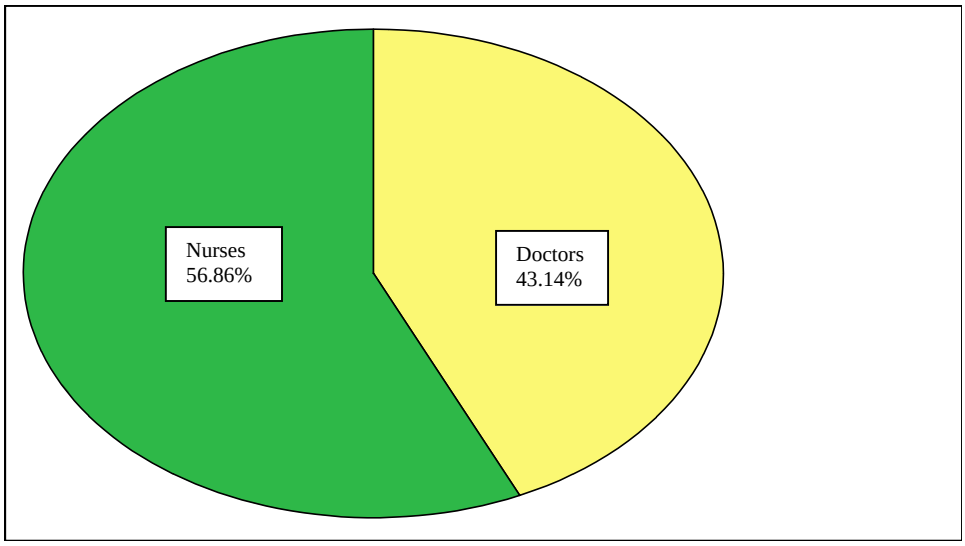

Figure 4.2: Clinical positions

Of the respondents 56.86% of them were nurses and 43.14% were doctors that made up the clinical stakeholders in the hospital. For this study the sample distribution did not include clinical staff members such as hospital managers, hospital executives, and other back office staff. The focus group was primarily the clinical stakeholders who interacted with the patients and used patient support information systems.

4.2.1. Current clinical applications

In general IT today in hospitals is a way to help health care providers with a means of collecting, storing, retrieving, and transferring patient information electronically. Brailer and Teraswara (2003) in their study mention that "IT diffusion is greatest in administrative and financial applications such as patient registration, billing, and payroll whereas clinical applications, such as computerized provider order entry (CPOE) for drugs or other items (e.g., lab work) and electronic health records, are less diffused and that infrastructure technologies build the base that other technologies work from, and include both widely diffused technologies, such as e-mail and telecommunications, and those that are less common, such as

wireless connections and voice recognition." Table 4.1 illustrates the different clinical applications that the respondents were exposed to on a daily basis.

	Electronic Medical Records	Computerized Provider Order Entry	Computerized Provider Order Entry	Picture Archiving and Communications System	Other
Doctor	26.67%	23.33%	30%	16.67%	0%
Nurse	25.49%	13.73%	27.45%	13.73%	7.84%

Table 4.1: Clinical applications used in hospital

Table 4.1 above indicates that the respondents were familiar with clinical applications related to HIT. The majority of the respondents 57.12% used Electronic Health Records (EHR) and 30% of the doctors used Clinical Decision Support Systems (CDSS) previously. However, only 7.84% of the respondents indicated that they previously used other clinical applications such as Palm Digital Assistants (PDA) and other hand held devices. The next section discusses the research model elaborating the reasons behind the intention to use HIT by clinical stakeholders.

4.3. Research model

Understanding the acceptance of information technology by clinical stakeholders has broader ramifications for other organizations that also want to go paperless. This would prepare other organizations that are in the pursuit of going paperless and thereby also provide them with some guidance in ensuring that all factors are taken into consideration and that the systems are accepted by the respondents. Using the research model illustrated in Figure 4.3, it is possible to demonstrate empirically

the effects of enabling and inhibiting perceptions and preparedness of information technology usage in hospital, thereby providing theoretical strategies and guidance aimed at preparing future hospitals that are looking to become paperless.

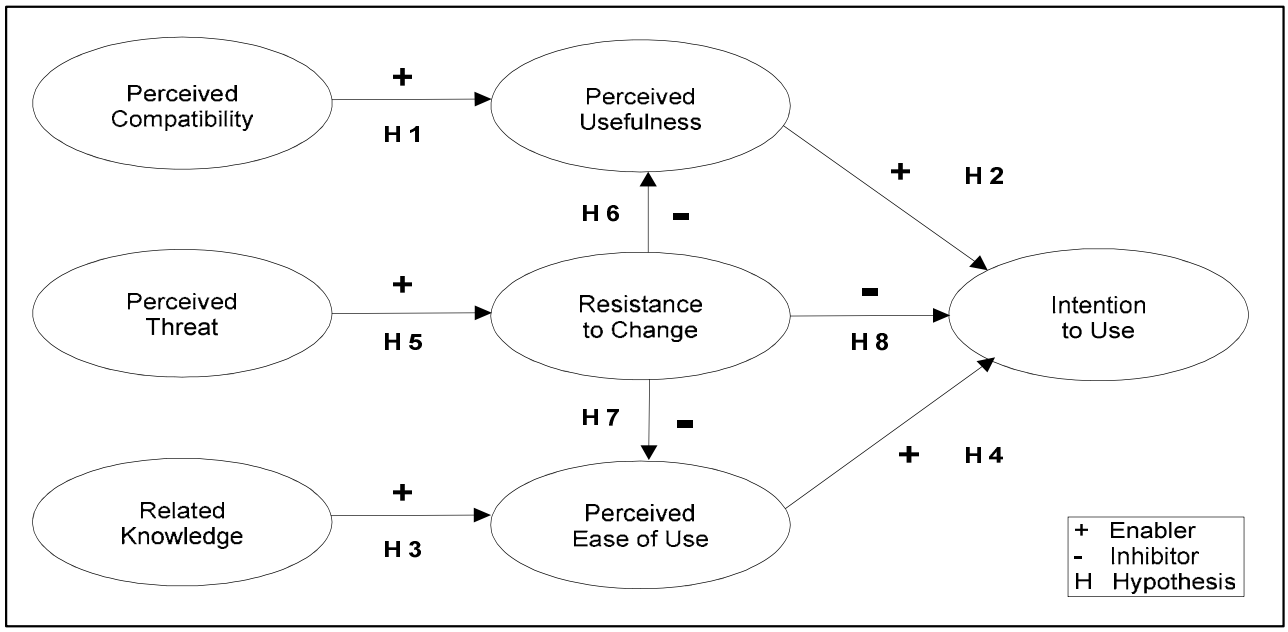

Figure 4.3: Research model used in study (Bhattacherjee & Hikmet, 2007)

The research model indicates that the usual enabler of information system usage which are perceived usefulness (PU) and perceived ease of use (PEOU) but more importantly the model illustrates the inhibitors to information system usage which are resistance to change and perceived threat. In addition to the enablers and inhibitors to information system usage illustrated, the diagram also indicates the eight (8) hypotheses that will be tested in the next sections of this chapter.

4.4. Factor analysis

A five point Likert scale was used as the primary means of gathering data from the respondents who completed the questionnaire. The Likert scale is arguably the most commonly used variation of the

summated rating scale. “Summated scales consist of statements that express either a favorable or unfavorable attitude towards the item of interest” (Cooper, 2001). Table 4.2 links the different sections of the questionnaire to the research model used in the study and indicate the Likert scale that was used.

Research Model Component	Section	Likert Scale
Perceived Compatibility	B9 – B13	Never = N, Seldom = S, Often = O, Most of the time = M, Always = A
Perceived Threat	F1 – F4	Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, Strongly Agree = SA
Related Knowledge	E5 – E6	None = N, Low = L, Average = A, High = H, Expert = E
Perceived Usefulness	D1 – D4	Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, Strongly Agree = SA
Resistance to Change	G1 – G4	Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, Strongly Agree = SA
Perceived Ease of Use	D5 – D8	Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, Strongly Agree = SA
Intention to use HIT	C1 – C11	Never = N, Seldom = S, Often = O, Most of the time = M, Always = A

Table 4.2: Questionnaire mapping with Likert scale

4.4.1. Kaiser-Meyer-Olkin analysis

In order to justify a factor analysis to be done on a given set of data, the most commonly used statistical analysis used is the Kaiser-Meyer-Olkin (KMO) measure. “The KMO measure of sampling adequacy

tests whether the partial correlations among variables are small while Bartlett's test of sphericity tests whether the correlation matrix is an identity matrix, which would indicate that the factor model is inappropriate" (Cooper, 2001). The greater the value of the KMO test is, the greater is the justification for a factor analysis to be conducted. "Another indicator of the strength of the relationship among variables is Bartlett's test of sphericity, which is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated" (Cooper, 2001). Table 4.3 illustrates the results received from the KMO test for each sub section of the questionnaire.

Research Model Component	**Section in Questionnaire**	**KMO Adequacy**	**Bartlett's Test of Sphericity**		
			Chi^2	**df**	**Sig.**
Perceived Compatibility	B9 – B13	0.814	661.584	10	0.000
Perceived Threat	F1 – F4	0.706	835.149	6	0.000
Related Knowledge	E5 – E6	0.500	57.540	1	0.000
Perceived Usefulness	D1 – D4	0.811	800.397	6	0.000
Resistance to Change	G1 – G4	0.639	612.502	6	0.000
Perceived Ease of Use	D5 – D8	0.751	369.652	6	0.000
Intention to use HIT	C1 – C11	0.830	1354.867	55	0.000

Table 4.3: KMO adequacy

Table 4.3 indicates that a Kaiser-Meyer-Olkin adequacy measure of >= 0.500 was achieved for all the questions in the questionnaire indicating that an adequate correlation does exist among the questions to justify the factor analysis. The next step is to perform the measures of sampling adequacy (MSA) for the individual questions in the questionnaire. For each of the dimensions tested from Table 4.3, the MSA for each question was > 0.5 which justifies factor analysis being conducted for the data that was collected.

4.4.2. Frequency of respondents' perceived compatibility

In order to measure the perceived compatibility of HIT by the clinical stakeholders, section B in the questionnaire handed to the clinical stakeholders included questions relating to the compatibilities of the current HIT in the hospitals. A five point Likert scale was used and the applicable responses were from Never = N, Seldom = S, Often = O, Most of the time = M, and Always = A. Table 4.4 depicts the different frequencies of the respondents for section B in the questionnaire.

#	Question	Never	Seldom	Often	Most	Always	Total
B9	How often does this hospital's current system provide precise information that you need?	3.92 %	0%	23.53%	35.29%	37.25%	**100%**
B10	How often are the hospital's current systems accurate?	0%	0%	27.45%	35.29%	37.25%	**100%**
B11	How often do you think the results presented from the hospitals current systems are of a useful and clear format?	0%	3.92%	19.61%	35.29%	41.18%	**100%**
B12	Are the systems implemented in the hospital currently easy to use?	0%	3.92%	19.61%	39.22%	37.25%	**100%**
B13	How often do the current systems implemented at this hospital give you the information you need in time?	0%	7.84%	15.69%	43.14%	33.33%	**100%**

Table 4.4: Frequency of perceived compatibility

Table 4.4 illustrates that the current HIT systems that the clinical stakeholders used on a daily basis more often than not or always (mean = 96.08%) provide accurate information which is required and displayed in a clear and useful format. This illustrates that the clinical stakeholders were comfortable with the current HIT and more importantly highlights that any new HIT that is to be implemented must conform to these compatibilities in order to increase the perceived usefulness of the system and if not this could result in a lack of system usage. Having conformed to the MSA of 0.814 (Table 4.3), the next step is to extract the Eigenvalue from the data analyzed. The sum of all the variances of the respective factors makes up the Eigenvalues and Cooper (2000) notes that "when divided by the number of variables, an Eigenvalue yields an estimate of the amount of total variance explained by the factor."

The questions in section B of the questionnaire were grouped together in order to measure the perceived compatibility of HIT by the clinical stakeholders and, therefore, the method of extracting a single factor is the preferred method of analysis. Table 4.5 illustrates the different Eigenvalues for perceived compatibility. The factor that is in bold is accepted as the operational scale as this is the highest factor in the loading table. Cooper (2000) notes that the term: "loading" refers to "the correlation coefficients that exists between the factors and the variables."

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**4.22**	**84.36**	**84.36**	**4.22**	**84.36**	**84.36**
2	.384	7.686	92.042			
3	.271	5.426	97.468			
4	.099	1.975	99.442			
5	.028	.558	100.000			

Extraction Method: Principal Component Analysis.

Table 4.5: Total variance of perceived compatibility

Any Eigenvalues < 1 are deemed not acceptable and the Eigenvalue with the highest variance and cumulative percentage is the accepted Eigenvalue. Hwang and Nettleton (2003) indicate that, traditionally, the highest Eigenvalue is normally accepted to predict the response variable and state that "restricting attention to principal components with the largest Eigenvalues helps to control variance inflation but can introduce high bias by discarding components with small Eigenvalues that may be most associated to predict the response variable." Table 4.5 indicates that the highest acceptable Eigenvalue is (ε= 4.22) which has a variance percentage of 84.36% and a cumulative percentage of 84.36%. The Eigenvalue (ε= 4.22) is thus the one used to predict the Y variable which is perceived usefulness.

4.4.3. Frequency of respondents perceived threat

In order to measure the perceived threat posed by HIT to the clinical stakeholders, section F in the questionnaire included questions relating to the threats the clinicians felt that a HIT implementation would bring. A five point Likert scale was used and the applicable responses were from Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, and Strongly Agree = SA. Table 4.6 depicts the different frequencies of the respondents for section F in the questionnaire.

#	Question	Strongly Disagree	Disagree	Never	Always	Strongly Agree	Total
F1	Do you feel that you may loose control over the way you currently do your daily activities if you had to use computerized clinical applications in a paperless environment?	12.75 %	32.35%	35.29%	19.61%	0%	**100%**
F2	Do you feel that you may loose control over the way you make clinical decisions if you had to use computerized clinical applications in a paperless environment?	12.75%	27.45%	36.27%	19.61%	3.92%	**100%**
F3	Do you feel that you may loose control over the way you order patients tests if you had to use computerized clinical applications in a paperless environment?	12.75%	35.29%	32.35%	15.69%	3.92%	**100%**
F4	Do you feel that you may loose control over the way you access clinical information such as patient data and lab results if you had to use computerized clinical applications in a paperless environment?	12.75%	27.45%	40.20%	15.69%	3.92%	**100%**

Table 4.6: Frequency of perceived threat

Most of the respondents did not agree neither did they disagree that they perceived an HIT implementation of a paperless environment as a threat to their current jobs. Interestingly, however, 23.53% of the respondents were in agreement that if computerized clinical applications could possibly lead to them losing control over making clinical decisions and 19.61% of the respondents were of the opinion that they would lose control in the way they ordered or accessed critical client information.

Having conformed to the MSA of 0.706, the next step was to extract one Eigenvalue from the data analyzed. The sum of all the variances of the respective factors in section F makes up the Eigenvalues for the perceived threat of HIT. The questions in section B of the questionnaire were grouped together in order to measure the perceived compatibility of HIT by the clinical stakeholders and, therefore. the method of extracting a single factor is the preferred method of analysis. Table 4.7 illustrates the different Eigenvalues for perceived compatibility. The factor that is in bold is accepted as the operational scale as this is the highest factor in the loading table.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**3.72**	**93.05**	**93.05**	**3.72**	**93.05**	**93.05**
2	.220	5.507	98.556			
3	.053	1.321	99.877			
4	.005	.123	100.000			

Extraction Method: Principal Component Analysis.

Table 4.7: Total variance of perceived threat

There is only one Eigenvalue from Table 4.7 that is deemed as acceptable in predicting the Y variable. The highest acceptable Eigenvalue is (ε = 3.72) which has a variance percentage of 84.36% and a

cumulative percentage of 93.05%. The Eigenvalue (ε = 3.72) is thus the one used to predict the Y variable which is resistance to change.

4.4.4. Frequency of respondents' related knowledge

In order to measure the related knowledge of HIT by the clinical stakeholders, section E in the questionnaire handed to the clinical stakeholders included questions relating to the related knowledge of HIT. A five point Likert scale was used and the applicable responses were from N = None, Low = L, Average = A, High = H, and Expert = E. This section also included many other questions that did not require a five point Likert scale but required "yes/no" answers. This facilitated the respondents in answering the questionnaires quickly and gave the researcher a more generalized perception of the respondent's actual related knowledge of HIT and information systems in general. Table 4.8 depicts the different frequencies of the respondents for section E in the questionnaire.

#	Question	None	Low	Average	High	Expert	Total
E5	If you do use clinical applications in the hospital, how would you rate your computer skills in working with the clinical applications in the hospital?	3.92%	11.76%	44.12%	36.27%	3.92%	**100%**
E6	How would you rate your computer skills in using Microsoft applications such as Microsoft Word, Microsoft Excel, and Microsoft PowerPoint etc…?	3.92%	7.84%	51.96%	19.61%	16.67%	**100%**

Table 4.8: Frequency of related knowledge

The majority of the respondents indicated that they were computer literate and were exposed to the current HIT applications at the hospital. Most of the respondents also indicated that they were well

versed with other computer applications including email and looking up information on the World Wide Web. From Table 4.8, 84.31% of the respondents indicated that they rated themselves as having average or above average, computer skills and 88.30% of the respondents note that they are comfortable using general computer applications such as Microsoft Word and Excel. This indicates that the majority of respondents were computer literate and, therefore, it may not be difficult for the respondents to adapt to a new HIT system provided they were trained thoroughly on the system.

Having conformed to the MSA of 0.500, the next step is to extract one Eigenvalue from the data analyzed. The sum of all the variances of the respective factors in section E makes up the Eigenvalues for the perceived threat of HIT. The questions in section E of the questionnaire were grouped together in order to measure the perceived compatibility of HIT by the clinical stakeholders and, therefore, the method of extracting a single factor is the preferred method of analysis. Table 4.9 illustrates the different Eigenvalues for perceived compatibility. The factor that is bolded is accepted as the operational scale as this is the highest factor in the loading table.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**1.66**	**83.11**	**83.11**	**1.66**	**83.11**	**83.11**
2	.338	16.885	100.000			

Extraction Method: Principal Component Analysis.

Table 4.9: Total variance of related computer knowledge

Table 4.9 illustrates only one Eigenvalue that is acceptable in predicting the Y variable. The highest acceptable Eigenvalue is ($\varepsilon = 1.66$) which has a variance percentage of 83.11% and a cumulative

percentage of 83.11%. The Eigenvalue ($\varepsilon = 1.66$) is thus the one used to predict the Y variable which is the related knowledge of clinical stakeholders.

4.4.5. Frequency of respondents' perceived usefulness

In order to measure the perceived usefulness of HIT by the clinical stakeholders, section D1-4 in the questionnaire included questions relating to the usefulness of a paperless environment replacing the current paper oriented hospitals. A five point Likert scale was used and the applicable responses were Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, and Strongly Agree = SA. Table 4.10 depicts the different frequencies of the respondents for section D1-4 in the questionnaire.

#	Question	SD	D	N	A	SA	Total
D1	Would the implementation of clinical applications at this hospital to establish a paperless environment be worth the time and effort to use it?	12.75%	0%	27.45%	27.45%	32.35%	**100%**
D2	Do you think that implementing clinical applications in this hospital would improve your departments work efficiency?	12.75%	0%	19.61%	35.29%	32.35%	**100%**
D3	Do you think that implementing clinical applications in this hospital would improve your departments work accuracy?	12.75%	3.92%	23.53%	23.53%	36.27%	**100%**
D4	Would the implementation of clinical applications at this hospital to establish a paperless environment improve your department's quality of work?	12.75%	3.92%	15.69%	27.45%	40.20%	**100%**

Table 4.10: Frequency of perceived usefulness

The majority of the respondents in the study believed that implementing a paperless environment at the hospital would be of some beneficial assistance to them. More than half of the respondents, (59.8%)

indicated that implementing a paperless environment was worth the time and effort and only 12.75% of the respondents believed that a paperless environment will not help improve the efficiency of the hospital. More than half (59.8%) of the respondents were under the impression that a paperless environment would improve the accuracy and quality of work in the respective departments at the hospital.

Having conformed to the MSA of 0.811, the next step is to extract one Eigenvalue from the data analyzed. The sum of all the variances of the respective factors in section D1-4 makes up the Eigenvalues for the perceived threat of HIT. The questions in section D1-4 of the questionnaire were grouped together in order to measure the perceived usefulness of HIT by the clinical stakeholders and, therefore, the method of extracting a single factor was the preferred method of analysis. Table 4.11 illustrates the different Eigenvalues for perceived usefulness. The factor that is in bold is accepted as the operational scale as this is the highest factor in the loading table.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**3.83**	**95.81**	**95.81**	**3.83**	**95.81**	**95.81**
2	.112	2.796	98.610			
3	.036	.895	99.505			
4	.020	.495	100.000			

Extraction Method: Principal Component Analysis.

Table 4.11: Total variance of perceived usefulness

Table 4.11 illustrates only one Eigenvalue that is acceptable in predicting the Y variable. The highest acceptable Eigenvalue is (ε = 3.83) which has a variance percentage of 95.81% and a cumulative

percentage of 95.81%. The Eigenvalue ($\varepsilon = 3.83$) is thus the one used to predict the Y variable which is the perceived usefulness of clinical applications in the hospital.

4.4.6. Frequency of respondents' resistance to change

In order to measure the resistance of HIT by the clinical stakeholders, section G in the questionnaire included questions relating to the resistance of a paperless environment replacing the current paper oriented hospitals. A five point Likert scale was used and the applicable responses were Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, and Strongly Agree = SA. Table 4.12 depicts the different frequencies of the respondents for section G in the questionnaire.

#	Question	SD	D	N	A	SA	Total
G1	I do not want the paperless environment to change the way you order you currently order patient tests?	3.92%	20.59%	24.51%	35.29%	15.69%	**100%**
G2	I do not want the paperless environment to change the way you order you currently make clinical decisions?	3.92%	20.59%	20.59%	35.29%	19.61%	**100%**
G3	I do not want the paperless environment to change the way you order you currently interact with other people in your job?	3.92%	15.69%	16.67%	51.96%	11.76%	**100%**
G4	I do not want the paperless environment to environment change the way you order you currently do your daily job?	3.92%	7.84%	24.51%	48.04%	15.69%	**100%**

Table 4.12: Frequency of resistance to change

An interesting statistic extracted from the Table 4.12 is that 63.72% resisted the implementation of a paperless environment if it would change the manner in which the clinical stakeholders interacted with the patients. This could be related to the fact that the relationship between the health care clinician and

patient has always been at a personal level with very little or no information technology involved. More than half of the respondents (50.98%) resisted using clinical applications that would change the way they currently ordered patient tests and 51.9% of the respondents did not want the clinical applications to change the way they made clinical decisions. It is human nature to be accustomed to your daily routine and hence 63.73% of the respondents would not want the clinical applications to change the manner in which they carried out their daily activities.

Having conformed to the MSA of 0.639, the next step is to extract one Eigenvalue from the data analyzed. The sum of all the variances of the respective factors in section G makes up the Eigenvalues for the perceived threat of HIT. The questions in section G of the questionnaire were grouped together in order to measure the perceived threat of HIT by the clinical stakeholders and therefore the method of extracting a single factor is the preferred method of analysis. Table 4.13 illustrates the different Eigenvalues for perceived threat. The factor that is bolded is accepted as the operational scale as this is the highest factor in the loading table.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**3.43**	**85.84**	**85.84**	**3.43**	**85.84**	**85.84**
2	.487	12.173	98.017			
3	.059	1.463	99.480			
4	.021	.520	100.000			

Extraction Method: Principal Component Analysis.

Table 4.13: Total variance of resistance to change

Table 4.13 illustrates only one Eigenvalue that is acceptable in predicting the Y variable. The highest acceptable Eigenvalue is (ε = 3.43) which has a variance percentage of 85.84% and a cumulative percentage of 85.84%. The Eigenvalue (ε = 3.43) is thus the one used to predict the Y variable which is the resistance to change of clinical stakeholders in using HIT.

4.4.7. Frequency of respondents' perceived ease of use

In order to measure the perceived ease of use of HIT applications by the clinical stakeholders, section D5-8 in the questionnaire handed to the clinical stakeholders included questions relating to the perceived ease of use of a paperless environment replacing the current paper oriented hospitals. A five point Likert scale was used and the applicable responses were Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, and Strongly Agree = SA. Table 4.14 depicts the different frequencies of the respondents for section D5-8 in the questionnaire.

#	Question	SD	D	N	A	SA	Total
D5	Do you think that implementing clinical applications in this hospital would improve your own tasks?	12.75%	3.92%	15.69%	27.45%	40.20%	**100%**
D6	Do you think that the systems in a paperless environment will be easy to use?	12.75%	3.92%	23.53%	23.53%	36.27%	**100%**
D7	Do you think you find it easy to get the system to do what you want it to do?	12.75%	3.92%	19.61%	27.45%	32.35%	**100%**
D8	Do you think you find it easy to become skilled at using the system?	8.82%	0%	19.61%	35.29%	36.27%	**100%**

Table 4.14: Frequency of perceived ease of use

From Table 4.14 it can be seen that a vast majority of the respondents perceived the clinical applications that would accompany a paperless environment as very useful. Of the respondents 67.65% of them either agreed or strongly agreed that the implementation of clinical applications in a paperless environment will improve their own tasks. More than 59% of the respondents were in agreement that the clinical applications in a paperless environment will be easy to use and will provide the respondents with the information they require. In terms of learning to grasp the system 71.56% of the respondents mentioned that they would find it easy at becoming skilled in using the system.

Having conformed to the MSA of 0.751, the next step is to extract one Eigenvalue from the data analyzed. The sum of all the variances of the respective factors in section D5-8 makes up the Eigenvalues for the perceived ease of use of HIT. The questions in section D5-8 of the questionnaire were grouped together in order to measure the perceived compatibility of HIT by the clinical stakeholders and, therefore, the method of extracting a single factor is the preferred method of analysis. Table 4.15 illustrates the different Eigenvalues for perceived ease of use. The factor that is in bold is accepted as the operational scale as this is the highest factor in the loading table.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**2.83**	**70.63**	**70.63**	**2.83**	**70.63**	**70.63**
2	.949	23.717	94.347			
3	.176	4.392	98.739			
4	.050	1.261	100.000			

Extraction Method: Principal Component Analysis.

Table 4.15: Total variance of perceived ease of use

Table 4.15 illustrates only one Eigenvalue that is acceptable in predicting the Y variable. The highest acceptable Eigenvalue is (ε = 2.83) which has a variance percentage of 70.63% and a cumulative percentage of 70.63%. The Eigenvalue (ε = 2.83) is thus the one used to predict the Y variable which is the intention to use HIT.

4.4.8. Frequency of respondents' intention to use HIT

The research model used for this study is centred on perceived ease of use and perceived use, and the manner in which they become inherent enablers for HIT usage. In order to measure the intention of clinical stakeholders to use HIT, section C in the questionnaire included questions relating to whether or not they will use the clinical applications in a paperless environment to perform certain activities. A five point Likert scale was used and the applicable responses were from Never = N, Seldom = S, Often = O, Most of the time = M, and Always = A. Table 4.16 depicts the different frequencies of the respondents for section C in the questionnaire when asked how often they would use the clinical applications in a paperless environment to perform the tasks listed in the table.

#	Question	N	S	O	M	A	Total
C1	Review the patient's problems	3.92 %	15.69%	28.43%	19.61%	32.33%	**100%**
C2	Seek out specific information from patients records	15.69%	0%	24.51%	23.53%	36.27%	**100%**
C3	Obtain results from tests	7.84%	7.84%	28.43%	11.76%	44.12%	**100%**
C4	Enter daily notes	3.92%	11.76%	16.67%	19.61%	48.04%	**100%**
C5	Order clinical laboratory analysis	7.84%	7.84%	16.67%	15.69%	51.96%	**100%**
C6	Obtain the results from clinical laboratory analysis	3.92%	11.76%	16.67%	19.61%	48.04%	**100%**
C7	Refer patients to other departments or specialists	15.69%	3.92%	24.51%	11.76%	44.12%	**100%**
C8	Write prescriptions	27.45%	15.69%	16.67%	11.76%	28.43%	**100%**
C9	Collect patient information	0%	3.92%	11.76%	23.53%	51.93%	**100%**
C10	Complete ad-hoc tasks such as leave forms, claim forms etc…	3.92%	16.67%	15.69%	19.61%	44.12%	**100%**
C11	Give general medical information to patients	11.76%	12.75%	15.69%	23.53%	36.27%	**100%**

Table 4.16: Frequency of intention to use HIT

The research model used in the study was to verify the HIT acceptance by clinical stakeholders in paperless environment. The majority of the respondents indicated that if the hospital had to become paperless they would use the clinical applications to perform all the activities listed in the Table 4.16. The only exception to this is that 43.14 % of the respondents indicated that they would not like to use the clinical applications to write prescriptions. This is justifiable as the current mechanism of writing prescriptions in many of the hospitals is still a very manual process whereby prescriptions are handwritten and given to patients.

Having conformed to the MSA of 0.830, the next step is to extract one Eigenvalue from the data analyzed. The sum of all the variances of the respective factors in section C makes up the Eigenvalues for the perceived threat of HIT. The questions in section C of the questionnaire were grouped together in order to measure the perceived compatibility of HIT by the clinical stakeholders and, therefore, the method of extracting a single factor is the preferred method of analysis. Table 4.17 illustrates the different Eigenvalues for intention to use HIT. The factor that is in bold is accepted as the operational scale as this is the highest factor in the loading table.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**6.83**	**62.06**	**62.06**	**6.83**	**62.06**	**62.06**	**5.54**	**50.37**	**50.37**
2	1.258	11.438	73.499	1.258	11.438	73.499	2.403	21.849	72.221
3	1.002	9.111	82.610	1.002	9.111	82.610	1.143	10.389	82.610
4	.686	6.238	88.848						
5	.375	3.412	92.260						
6	.366	3.324	95.585						
7	.216	1.963	97.547						
8	.157	1.425	98.972						
9	.072	.657	99.629						
10	.024	.218	99.847						
11	.017	.153	100.000						

Extraction Method: Principal Component Analysis.

Table 4.17: Total variance of intention to use HIT

Table 4.17 illustrates three Eigenvalue that is acceptable in predicting the Y variable. The highest acceptable Eigenvalue is (ε = 6.83) which has a variance percentage of 62.06% and a cumulative

percentage of 62.06%. The Eigenvalue ($\varepsilon = 6.83$) is thus the one used to predict the Y variable which is the resistance to change of clinical stakeholders in using HIT.

4.4.9. Cronbach's coefficient alpha

Having determined the dimensions of the scale used in the questionnaire in the next chapters the next step is to test the actual reliability of the measurement instrument used in the study. The Cronbach's coefficient alpha method was used to measure the reliability and consistency of the measurement instrument used for the study. Cronbach's coefficient alpha test is a "reliability technique that requires only a single test administration to provide a unique estimate of the reliability for a given test" (Cooper, 2002). The Cronbach's coefficient alpha normally ranges between 0 and 1 and the closer the alpha is to 1 the greater the reliability is of the instrument. Table 4.18 illustrates the alpha measurements calculated for each section of the questionnaire.

Section	Cronbach's Coefficient Alpha	Number of questions
Perceived Compatibility	0.953	5
Intention to use HIT	0.876	11
Perceived Usefulness	0.985	4
Perceived Ease of Use	0.546	4
Related Knowledge	0.793	2
Perceived Threat	0.975	4
Resistance to change	0.944	4

Table 4.18: Cronbach's coefficient alpha

As a rule of thumb any calculated Cronbach's coefficient alpha that is less than 0.5 is deemed unacceptable. Table 4.18 indicates that all the Cronbach coefficient alpha's calculated are greater than 0.5 meaning that the 7 sections, perceived compatibility, intention to use HIT, perceived usefulness, perceived ease of use, related knowledge, perceived threat and resistance to change are valid and reliable instruments to measure and quantify the research model used in this study. The next step is to test the hypotheses and this is done in the following sections.

4.5. Perceived compatibility of information systems

The implementation of information systems often means that clinical stakeholders will have to come out of their comfort zones and familiarize themselves with an environment that is not paper based. The introduction of clinical applications will require that clinical stakeholders, change the way they order, create and retrieve patient information. A major downfall with many system implementations is that the current traditional routines and compatibilities are not taken into consideration. Miller and Sim (2004) mention that one of the reasons for implementing information systems with close proximity to the traditional systems and structures would make the system easier to use and will accelerate the adoption and system usage.

Medical diagnosis and treatment is sometimes not straightforward and can be very tedious as it could require the interaction of many different source systems, interaction with different health care practitioners and different treatments which sometimes needs to be done simultaneously. However, more often than not systems that are built do not take into consideration the current capabilities of the clinical stakeholders and HIT systems designed by the vendor may sometimes force the clinical staff to change their way of working to accommodate the new system (Bhattacherjee & Hikmet, 2007).

However, as Chau and Hu (2002) indicate that perceived usefulness is not directly influenced by system compatibility. Contrary to this, many researchers have argued that if a system cannot cater for a health care practitioner's needs then the system cannot be perceived to be useful to that health care practitioner's needs. Therefore, in light of the arguments mentioned above the researcher proposes the following hypothesis:

H1: The perceived compatibility of HIT by clinical stakeholders is an enabler to their perceived usefulness of HIT usage.

Section B of the questionnaire was dedicated to analysing the perceived compatibility of the current systems that the clinical stakeholders use. The next section further elaborates on the results received pertaining to the perceptions that the clinical stakeholders have regarding their current HIT.

4.5.1. Hypothesis testing: H1

In order to test this hypothesis, partial least squares (PLS) was used. PLS due to its general strategy is often referred to as "Projection of Latent Structures." The main advantage of PLS amongst others is its ability to model multiple dependents and multiple independents. In SPSS, PLS has been implemented as a regression model which, therefore, suffices as the objective of this chapter is to validate the research model chosen for this study. However, PLS is also implemented as a path model or a predictor of dependents from a set of independents in other software programs such as SAS's PROC PLS and SmartPLS (Cooper, 2002). The first step towards testing the H1 hypothesis is to get the adjusted R^2 of the latent factors. The next section discusses this in more detail.

4.5.1.1. Adjusted R^2: H1

In determining if the perceived compatibility of clinical applications is an enabler for their perceived usefulness, the perceived usefulness responses were chosen as the dependent variables and the perceived compatibilities were then the independent variables in the PLS algorithm. The latent factors extracted from the PLS algorithm are the linear combinations of the manifest of the perceived compatibilities responses. Table 4.19 illustrates the extracted latent factors together with the X variances, Y variances, cumulative X variances, cumulative Y variances and the adjusted R^2.

Proportion of Variance Explained

	Statistics				
Latent Factors	X Variance	Cumulative X Variance (R^2)	Y Variance	Cumulative Y Variance (R^2)	Adjusted R^2
1	.123	.123	.145	.145	.136
2	.776	.899	.014	.158	.141
3	.073	.972	.002	.161	.135
4	.016	.988	.006	.166	.132
5	.012	1.000	.002	.169	.125

Table 4.19: Adjusted R^2 for H1

The PLS model indicates that the cumulative X variance and the cumulative Y variance is the percent of variance in the X variable and Y variable, respectively which are accounted for by the latent factors, of which in regression is interpreted as the cumulative R^2. The last column in the table is the adjusted R^2 table which actually penalizes for model complexity. Garson (1998) in explaining the adjusted R^2 states that the "adjusted R^2 actually declines with increasing numbers of factors because the added variance explained is less than the complexity penalty factor". This means that the more a latent factor explains the variation in the Y and X variables, the more adhered it is to explaining variations in a

sample of dependent and independent variables respectively. All of the R^2 values above are greater than 0.05 ($R^2 > 0.05$) indicating that the variation of the perceived compatibilities and the variation of the perceived usefulness are important in explaining that perceived compatibilities of HIT is actually an enabler for perceived usefulness. The next section further elaborates on this by illustrating the PLS weights and loadings analysis gathered from the questionnaire.

4.5.1.2. Latent factor weights: H1

"Loading or weights indicate how much each independent variable contributes to the axis representing the column factor, while the sign indicates the direction of the correlation" (Garson, 1998). Table 4.20 indicates the independent weights which are the perceived compatibility, which represents the correlation of the independent variables (perceived compatibilities) with the dependent scores (perceived usefulness).

Weights

Variables	Latent Factors				
	1	2	3	4	5
B9*	-.538	-.136	-.064	.261	-.541
B10	.529	.951	-.533	.124	.027
B11*	-.552	-.192	-.395	-.520	.250
B12	.113	.661	.741	.751	.849
B13	.337	.819	.166	-.637	-.620
D4	.657	.079	.075	.130	.244
D3	.722	.066	.126	.420	.235
D2	.703	.024	.120	.148	.192
D1	.703	.055	.013	.356	.086

* Dropped from further analysis due to low factor loading

Table 4.20: Latent factor weights for H1

In applying PLS factor analysis Garson (1998) mentions that the rule of thumb loadings should be greater than 0.7 in order to confirm that the independent variables are actually represented by a particular factor. However, Garson goes on to state that the loading of ($\omega > 0.7$) is an unrealistic one in the actual, real world and that certain real life data may not meet this criteria. Studies that are exploratory in nature tend to use a more realistic loading factor of 0.4 for the central factor and 0.25 for other factors. The result from Table 4.20 illustrates that factors B9 and B11 were dropped from further analysis due to their low factor loading. The remaining independent weights indicate a correlation of greater than 0.4 for the central factor ($\omega > 0.4$) and a correlation of greater than 0.25 ($\omega > 0.25$) for the remaining factors meaning a positive correlation exists between the perceived compatibilities and the scores of the perceived usefulness.

4.5.1.3. Latent factor loadings: H1

The analysis of latent factor weights and latent factor loading generally are very similar in nature and more often than not provide the same use of interpreting results from a new sample of data. Table 4.21 illustrates the independent loading factors which represent the direction of the lines for each independent in X-space.

Loadings

Variables	Latent Factors				
	1	2	3	4	5
B9	-.971	.415	-.107	.640	-.666
B10	.123	.452	-.858	.377	.047
B11	-.935	.419	-.289	-.591	.574
B12	-.459	.477	.446	.142	.353
B13	-.153	.479	.551	-.585	-.315
D4	.492	.534	.561	.539	.527
D3	.504	.534	.569	.556	.525
D2	.504	.528	.574	.560	.531
D1	.501	.526	.561	.558	.520

Table 4.21: Latent factor loading for H1

"Loadings are used to impute meaning for the factors, which sometimes can be a difficult exercise to achieve when there is no simple factor structure devoid of cross loadings of variables on multiple factors" (Garson, 1998). The loadings achieved above illustrate a positive direction of independent factors towards the dependent factors having achieved a latent loading of higher than 0.4 ($\lambda > 0.4$). This further indicates a positive relation indicating that the perceived compatibility is an enabler for perceived usefulness of HIT. Once the loadings and weights have been calculated the next step is to understand the variable importance in projection (VIP) for the dependent variables. This is illustrated in the next section.

4.5.1.4. Variable importance in projection: H1

"VIP coefficients are used to measure the relative importance of each X variable for each X factor in the prediction model which means that that the VIP coefficients represent the importance of each X variable in fitting both the X and Y scores, since the Y scores are predicted from the X scores" (Garson, 1998).

The developer of the PLS method Wold (1994) indicates that a VIP coefficient that is less than 0.8 (VIP < 0.8) or a VIP coefficient that is small in absolute size can be dropped from the model. Table 4.22 illustrates the VIP coefficients for the independent variables used in testing hypothesis H1.

Variable Importance in the Projection

Variables	Latent Factors				
	1	2	3	4	5
B9	1.202	1.153	1.144	1.130	1.131
B10	1.182	1.291	1.290	1.269	1.260
B11	1.235	1.187	1.183	1.182	1.176
B12*	.254	.497	.534	.608	.644
B13	.754	.899	.893	.916	.924

* Dropped from further analysis due to low VIP coefficient

Table 4.22: Variable importance in projection for H1

Factor B12 in Table 4.22 was dropped from the model due to a low VIP coefficient (VIP < 0.8). The remaining VIP path coefficients conform to the regression model used for the study by having VIP coefficients larger than 0.8 (VIP > 0.8), indicating a positive projection of perceived compatibility of HIT as an enabler to perceived usefulness. Having achieved a positive projection in the regression model the final step is to achieve the individual path coefficients of the dependent variables. This is illustrated in the next and final section of testing hypothesis H1.

4.5.1.5. Path coefficient: H1

The final step in testing hypothesis H1 is to calculate the individual path coefficients for the dependent variables, namely the perceived usefulness factors. Garson (1998) states that the "parameter estimates are the regression coefficients used in conjunction with the independent variables, which are both categorical and covariate variables, to predict the dependent variables". Furthermore the sign of the path coefficient indicates the direction of the effect meaning that a positive path coefficient indicates the

likelihood of that path whilst a negative value illustrates the unlikelihood of that coefficient path. Table 4.23 illustrates the path coefficients for the perceived usefulness variables.

Path Coefficients

Independent Variables	Dependent Variables			
	D4	D3	D2	D1
(Constant)	1.938	1.997	2.536	2.136
B9	-.641	-.577	-.586	-.444
B10	.683	.730	.562	.743
B11	-.647	-.962	-.687	-.840
B12	.776	1.161	.685	.704
B13	.097	-.142	.090	.007

Table 4.23: Path coefficients for H1

The individual path coefficients of the dependent variables indicated a positive result, were D2 has the highest path coefficient of 2.536 ($\beta = 2.536$) and the lowest path coefficient being D4 which is 1.938 ($\beta = 1.938$). The mean of the dependent path coefficient is, therefore, calculated to be 2.15 ($\beta = 2.15$). The hypothesis H1 is therefore accepted due to the following empirical calculated support:

- Adjusted R_2 is greater than 0.05 ($R_2 > 0.05$)
- The latent factor weights have a correlation factor greater than 0.4 ($\omega > 0.4$) for the central factor and a correlation of greater than 0.25 ($\omega > 0.4$) for the remaining correlation factors
- The latent factor loading achieved is higher than 0.4 ($\lambda > 0.4$) indicating a positive relation of perceived compatibilities towards perceived usefulness
- VIP coefficients achieved are larger than 0.8 (VIP > 0.8) indicating a positive projection of perceived compatibility of HIT being an enabler of perceived usefulness

- The individual path coefficients for the dependent variables are positive in nature indicating that the independent variables (perceived compatibility) can be used to determine the dependent variables (perceived usefulness). The mean path coefficients for the dependent variables are 2.15 ($\beta = 2.15$).

The findings above confirm hypothesis H1 and illustrates that perceived compatibility has a strong and significant positive effect on perceived usefulness. The next section discusses the perceived use of clinical applications and tests the hypothesis that perceived usefulness is indeed an enabler to the intention use of HIT by clinical stakeholders.

4.6. Perceived use of clinical applications

Davis *et al.* (1989) define perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance." Perceived usefulness suggests that people will want to use the system because it will be of some benefit to them, and vice versa if no benefit is actually seen in the use of the system people will not see the use of the system. Therefore, the following hypothesis is put forward:

H2: *The perceived usefulness of HIT by clinical stakeholders is an enabler to their intention to use HIT.*

In determining the perceived usefulness of clinical applications in a paperless environment, the respondents were asked several questions to understand whether or not the clinical applications in a paperless environment would be beneficial to them in improving their efficiency and quality of care. A five point Likert scale was used with answers ranging from "Strongly Agree" to "Strongly Disagree". The research model indicates that perceived usefulness is an enabler to the intention to use HIT,

meaning that if the user perceives the technology as beneficial the likelihood of using that technology increases. Figure 4.4 illustrates the respondent's perceived usefulness of clinical applications in a paperless environment.

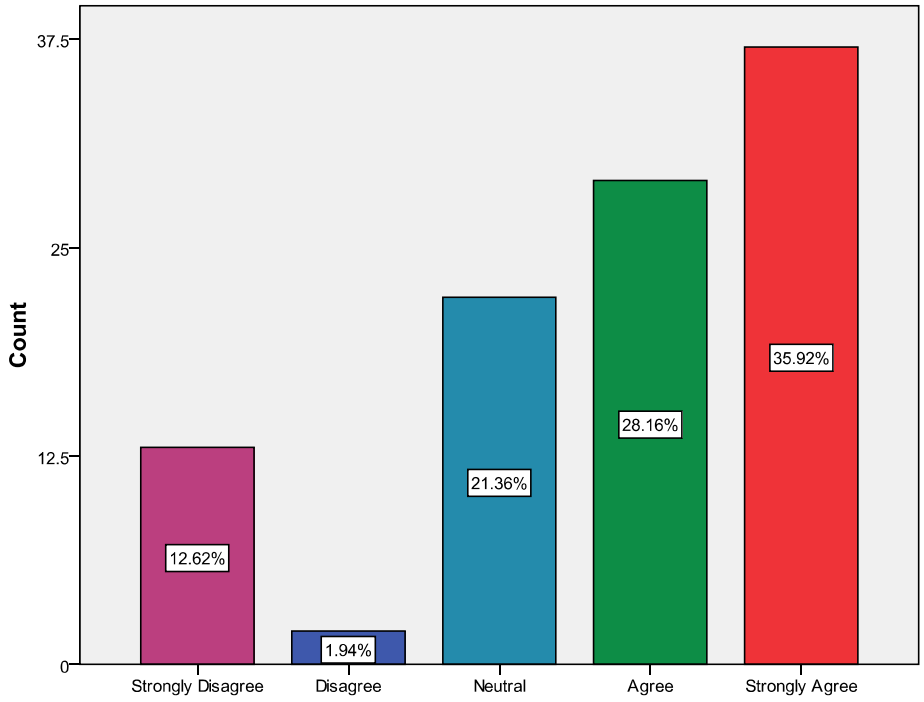

Figure 4.4: Perceived usefulness of clinical applications in hospital

Most of the respondents either "Strongly Agreed" (35.92%) or "Agreed" (28.16%) that the clinical applications in a paperless environment will be perceived as useful to them in conducting their daily activities whilst only 12.62% and 1.94% of the respondents "Strongly Disagreed" and "Disagreed" respectively with this sentiment. A possible reason for this is that many of the respondents perceived the clinical applications as compatible to their daily activities and would not change the way they currently executed their activities.

4.6.1. Hypothesis testing: H2

The first step towards testing the H2 hypothesis is to get the adjusted R^2 of the latent factors. The next section discusses this in more detail.

4.6.1.1. Adjusted R^2: H2

In determining whether the perceived usefulness of clinical applications is an enabler for clinicians intention to use HIT, the intention to use responses were chosen as the dependent variables and the perceived usefulness were then the independent variables in the PLS algorithm. The latent factors extracted from PLS algorithm are the linear combinations of the manifest of the perceived ease of use of clinical applications responses. Table 4.24 illustrates the extracted the latent factors together with the X variances, Y variances, cumulative X variances, cumulative Y variances and the adjusted R^2.

Proportion of Variance Explained

	Statistics				
Latent Factors	X Variance	Cumulative X Variance	Y Variance	Cumulative Y Variance (R^2)	Adjusted R^2
1	.958	.958	.184	.184	.175
2	.016	.974	.056	.240	.225
3	.016	.991	.046	.286	.264
4	.009	1.000	.022	.308	.279

Table 4.24: Adjusted R^2 for H2

All of the R^2 values above are greater than 0.05 ($R^2 > 0.05$) indicating that the variation of the perceived usefulness and the variation of the intention to use HIT are important in explaining that perceived

usefulness of HIT is actually an enabler for clinical stakeholders' intention to use HIT. The next section further elaborates on this by illustrating the PLS weights and loadings analysis gathered from the questionnaire.

4.6.1.2. Latent factor weights: H2

Table 4.25 indicates the independent weights which is the perceived usefulness, which represents the correlation of the independent variables (perceived usefulness) with the dependent scores which is the intention to use HIT.

Weights

Variables	Latent Factors			
	1	2	3	4
D1	.526	-.393	1.132	.240
D2	.473	.840	-.677	.149
D3	.494	-.093	-.260	-.863
D4	.505	-.364	-.193	.487
C11	.222	.241	1.351	1.605
C10	.355	-1.668	1.108	-.525
C9*	-.254	-.826	.709	-.824
C8	.147	-1.414	.648	.249
C7	.244	-1.687	1.183	-.237
C6	.242	-1.234	.476	-.054
C5	.222	-1.891	.725	.679
C4	.178	-.852	.826	1.259
C3	.176	-1.398	.701	.234
C2	.159	-.346	.927	.840
C1	.107	-1.254	.128	.148

* Dropped from further analysis due to low factor loading

Table 4.25: Latent factor weights for H2

The results from Table 4.25 illustrate that factor C9 was dropped from further analysis due to low factor loading. The remaining independent weights indicates a correlation of greater than 0.4 for the central factor ($\omega > 0.4$) and a correlation of greater than 0.25 ($\omega > 0.25$) for the remaining factors meaning that a positive correlation exists between the perceived usefulness and the scores of the intention to use HIT.

4.6.1.3. Latent factor loadings: H2

Table 4.26 illustrates the independent loading factors which represent the direction of the lines for each independent factor in X-space, where the dependent variables are the intention to use HIT and the independent variables are the perceived usefulness.

Loadings

Variables	Latent Factors			
	1	2	3	4
D1	.501	.325	.758	.023
D2	.504	.911	.045	.176
D3	.504	-.274	-.162	-.791
D4	.493	-.924	-.674	.585
C11	.286	-.186	.306	.409
C10	.330	-.191	.202	.179
C9	-.090	-.157	.157	-.099
C8	.272	-.317	.320	.356
C7	.345	-.350	.338	.322
C6	.379	-.377	.368	.525
C5	.382	-.393	.371	.542
C4	.355	-.370	.395	.625
C3	.387	-.432	.431	.623
C2	.342	-.365	.408	.622
C1	.346	-.420	.408	.640

Table 4.26: Latent factor loading for H2

The loadings achieved above illustrate a positive direction of independent factors towards the dependent factors having achieved a latent loading of higher than 0.4 ($\lambda > 0.4$). This further indicates a positive relation indicating that the perceived usefulness is an enabler for intention to use HIT. Once the loadings and weights have been calculated the next step is to understand the variable importance in projection (VIP) for the dependent variables. This is illustrated in the next section.

4.6.1.4. Variable importance in projection: H2

Table 4.27 illustrates the VIP coefficients for the independent variables used in testing hypothesis H2 where the dependent variables are the intention to use HIT and the independent variables are the perceived usefulness.

Variable Importance in the Projection

Variables	Latent Factors			
	1	2	3	4
D1	1.053	.996	1.289	1.249
D2	.946	1.162	1.195	1.155
D3	.988	.868	.822	.915
D4	1.010	.951	.885	.891

Table 4.27: Variable importance in projection for H2

The VIP path coefficients conformed to the regression model used for the study by having VIP coefficients larger than 0.8 (VIP > 0.8), indicating a positive projection of perceived usefulness of HIT as an enabler to intention to use HIT. Having achieved a positive projection in the regression model the final step is to achieve the individual path coefficients of the dependent variables. This is illustrated in the next and final section of testing hypothesis H2.

4.6.1.5. Path coefficient: H2

The final step in testing hypothesis H2 is to calculate the individual path coefficients for the dependent variables, namely; the intention to use HIT factors. Table 4.28 illustrates the path coefficients for the perceived usefulness variables.

Parameters

Independent Variables	Dependent Variables										
	C11	C10	C9	C8	C7	C6	C5	C4	C3	C2	C1
(Constant)	1.097	1.220	7.260	1.142	1.410	1.862	1.847	1.991	1.926	2.029	2.161
D1	2.103	1.943	1.610	1.768	2.368	1.079	1.882	1.579	1.516	1.258	.684
D2	-.404	-2.055	-2.897	-1.904	-2.467	-1.199	-1.933	-.961	-1.573	-.620	-1.011
D3	-1.712	.468	.926	-.212	.191	.142	-.477	-1.028	-.162	-.700	.008
D4	.563	.296	-.702	.688	.426	.407	.960	.768	.555	.355	.495

Table 4.28: Path coefficients for H2

The individual path coefficients of the dependent variables indicated a positive result. C9 in Table 4.28 has the highest path coefficient of 7.260 ($\beta = 7.260$) and the lowest path coefficient being C11 which is 1.097 ($\beta = 1.097$). The mean of the dependent path coefficient is therefore calculated to be 2.18 ($\beta = 2.18$). The hypothesis H2 is, therefore, accepted due to the following empirical calculated support:

- Adjusted R_2 is greater than 0.05 ($R_2 > 0.05$)
- The latent factor weights have a correlation factor greater than 0.4 ($\omega > 0.4$) for the central factor and a correlation of greater than 0.25 ($\omega > 0.4$) for the remaining correlation factors
- The latent factor loading achieved is higher than 0.4 ($\lambda > 0.4$) indicating a positive relation of perceived usefulness towards intention to use HIT

- VIP coefficients achieved are larger than 0.8 (VIP > 0.8) indicating a positive projection of perceived usefulness of HIT being an enabler of intention to use HIT
- The individual path coefficients for the dependent variables are positive in nature indicating that the independent variables (perceived usefulness) can be used to determine the dependent variables (intention to use). The mean path coefficients for the dependent variables are 2.18 ($\beta = 2.18$).

The findings above confirm hypothesis H2 and illustrate that perceived usefulness has a strong and significant positive effect on intention to use HIT. One of the leading inhibitors towards the adoption of HIT with many hospitals is the user acceptance. While IT in the health sector continues to rapidly evolve and transform it is also vital to have an insight into user's acceptance and perceptions towards the technologies that they will be faced with on a daily basis. A five point Likert scale was used to evaluate the acceptance of clinical applications by the clinical stakeholders in the hospital on a daily basis. Figure 4.5 graphically describes the findings achieved by the study.

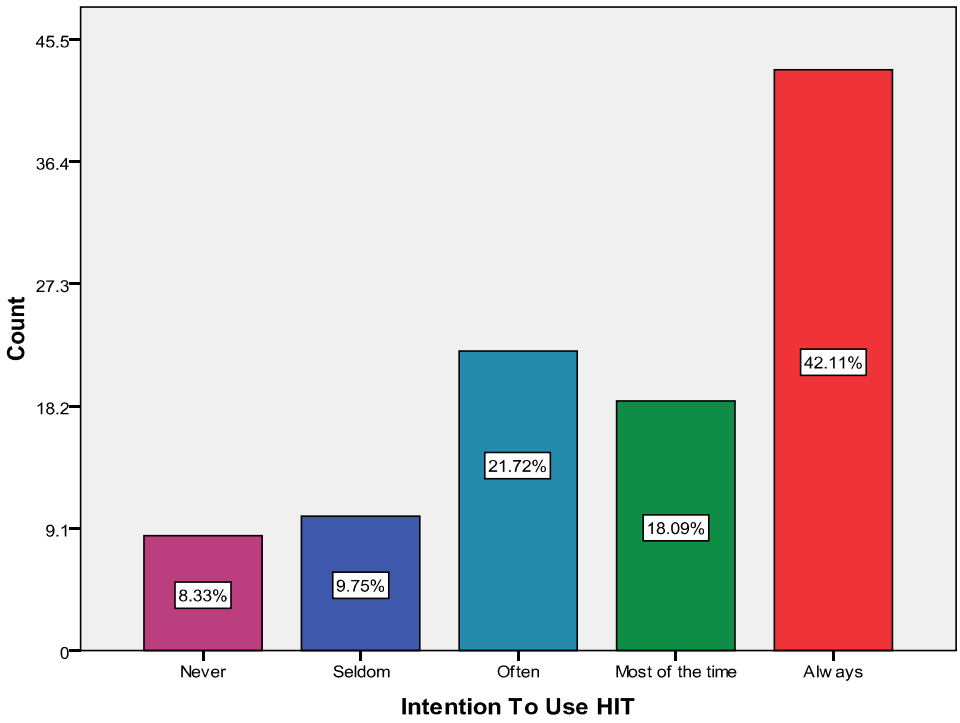

Figure 4.5: Intention to use HIT

Figure 4.5 is a bar graph that summarizes the intention to use HIT by the clinical stakeholders (n=102) that completed the questionnaire. The majority of the clinical stakeholders indicated that in a paperless environment they would use the clinical applications to go about conducting their daily activities. Interestingly enough, 42.11% of the clinical stakeholders indicated that they would "Always" use the clinical applications to conduct their daily tasks and only a minority of clinical stakeholders 8.33% indicated that they would "Never" use the clinical applications in a paperless environment. The research model thus indicates that the majority (81.92%, "Often", "Most of the time", "Always") of the respondents indicating a positive trend towards using the clinical applications in a paperless environment and the respondents perceived the clinical applications as easy to use and useful in conducting their daily activities. The next section discusses the related knowledge of clinical applications by the clinical stakeholders and tests the hypothesis that related knowledge is indeed an enabler to perceived ease of use of HIT.

4.7. Related knowledge

Related computer knowledge could also be described as familiarity with information technology and systems. A major stumbling block of many system implementations is the lack of insight given to the relevant clinical stakeholders of the systems. Research has shown that without having prior knowledge or familiarity with a certain technology, clinical stakeholders tends to lead to a lack of purpose for that technology. Bhattacherjee and Hikmet (2007) also note that having familiarity and knowledge of computer based tools in general could improve the users' attitudes towards a certain HIT. It could be expected then that clinical stakeholders that are familiar with IT in general would easily be able to use and learn a new system that would be implemented. Therefore, the following hypothesis is put forward:

H3: Related Knowledge of HIT by clinical stakeholders is an enabler to their perceived ease of use of HIT.

Section E of the questionnaire was used to determine the availability of computers in the hospital as well as in the wards the respondents worked in and the related computer knowledge of the respondents. The respondents were asked to self rate their knowledge of using computers, software programs, electronic email systems and their familiarity with basic Microsoft Office packages such as Microsoft Word and PowerPoint. Figure 4.6 illustrates the rating the respondents' gave themselves in using Microsoft applications.

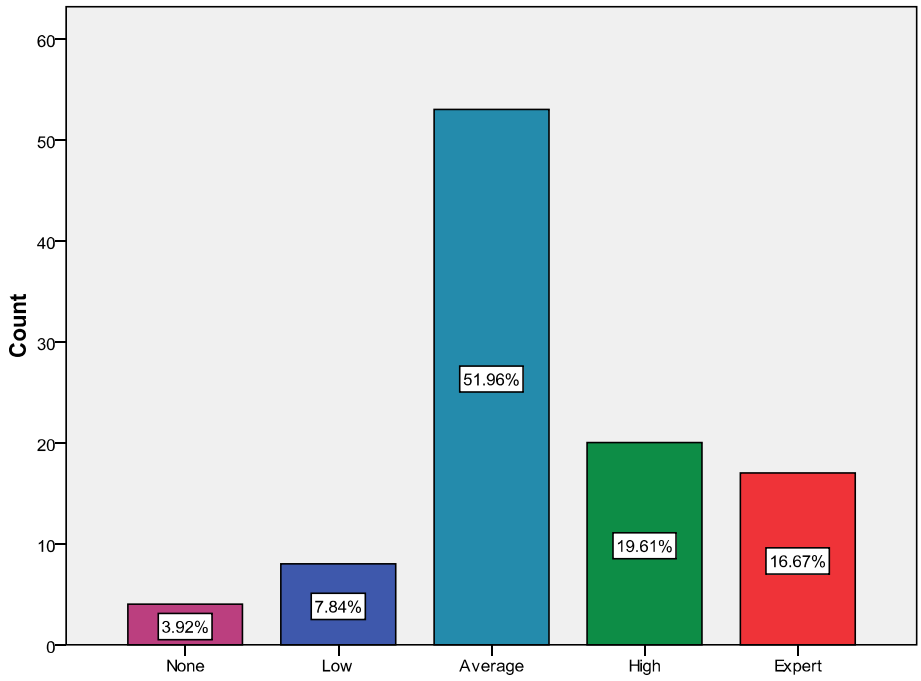

Figure 4.6: Related computer knowledge

The majority of the respondents indicated a fairly high level of basic computer literacy with 51.96% of the respondents indicating that they were "Average" in using Microsoft office applications such as Microsoft Word and PowerPoint while 19.61% and 16.67% of the respondents indicated their computer literacy to be "High" and "Expert" respectively. Another basic computer skill in today's technology driven world is the ability to use e-mail programs, such as Microsoft Outlook and Google Mail. Surprisingly 39.22% of the respondents indicated that had no exposure to such e-mail programs. Even though The majority of the respondents, 60.78% indicated they had exposure to e-mail programs, the percentage that do not have exposure remains a concern for organizations that would like to pursue the journey towards becoming paperless.

Given that related knowledge or lack thereof leads to clinical stakeholders having a negative perception of the actual use of the system, Johnson (2001) in his study of barriers that impede IT adoption in paediatric care states that courses should be developed for the health care stakeholders that would teach them not only computer literacy but also include relevant topics such as:

- Privacy, security and confidentiality of patient information
- Benefits that IT implementations bring to the hospital and how it can be used to alleviate some of the tedious work that the clinical stakeholders do on a daily basis
- Continuous training and support of the clinical applications and HIT systems.

Although today we are faced with barriers towards achieving computer literacy within the health care sector, basic computer skills in the near future will become a necessity as more and more activities become digitized. Parente (2003) describes computer literacy in the future as being as important to read and write in today's world. It is, therefore, important to ensure that clinical stakeholders are sent on training to be able to have basic computer skills. Figure 4.7 illustrates the clinical stakeholders that have received training in the hospital.

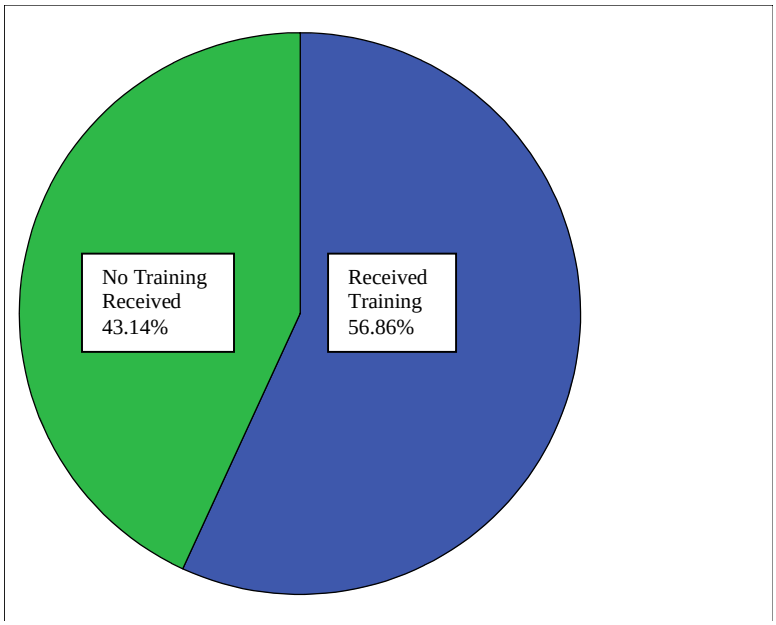

Figure 4.7: General computer training

Even though Figure 4.7 indicates that 56.86% of the respondents have received general computer training, the alarming statistic is that 43.14%, almost half of the respondents have not had any computer training. In a paperless environment whereby everything will be electronically processed this statistic is high and the stakeholders at the relevant hospitals that are looking to go paperless have to ensure that computer training is provided to the clinical stakeholders.

Another basic computer skill in today's technology driven world is the ability to use e-mail programs, such as Microsoft Outlook and Google Mail. Surprisingly 39.22% of the respondents indicated that they had had no exposure to such e-mail programs. Even though the majority of the respondents, 60.78% indicated they have exposure to e-mail programs, the percentage that did not have exposure remains a concern for organizations that would like to pursue the journey towards becoming paperless. There are a number of reasons that contributed to this lack of exposure to e-mail ranging from Internet availability to the availability of computers in hospitals. When asked whether or not the respondents have had exposure

to computerized electronic applications other than in the hospital they work in, 52.94% of the respondents indicated that they did, meaning that the respondents have had experience and training with the clinical applications previously. The need for hospitals to ensure that the health care professions receive adequate training is a necessity, to ensure that they become knowledgeable and experts in the system and this need will increase exponentially in a paperless environment.

4.7.1. Using ANOVA to analyze the level of computer literacy

An ANOVA (analysis of variance) is a "guide for determining whether or not an event was most likely due to the random chance of natural variation or, conversely, the same method provides guidance in saying at a 95% level of confidence that a certain factor (X) or factors (X, Y, and/or Z) were the more likely reason for the event" (Sloan, 2000).

An ANOVA, "sometimes called an F-test, is closely related to the t-test. The major difference is that, where the t-test measures the difference between the means of two groups, an ANOVA tests the difference between the means of two or more groups" (Sloan, 2000).

ANOVA was used to analyze the computer training received by the clinical stakeholders and determine if there was a significant difference in the training received between the different clinical stakeholders. The hypothesis is that there is actually a difference in the training received by the clinical staff. In this process, an alpha level of 0.05 was used to test each hypothesis. The following are the results that were obtained using one way ANOVA. Table 4.29 illustrates the summary of results from the one way ANOVA test.

Descriptives

Have you ever received computer training in general?

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Doctor	30	.53	.507	.093	.34	.72
Nurse	51	.51	.505	.071	.37	.65
Total	102	.43	.498	.049	.33	.53

Table 4.29: ANOVA summary of clinical stakeholders training

The summary Table 4.29 indicates the counts, means, and variances for the data. Table 4.29 indicates that 43% of respondents have received computer training and that more the 50% of both doctors and nurses did receive training indicating that there is no significant difference between the training that doctors or nurses received. Table 4.30 illustrates the homogeneity test of variance to determine if there is a significant difference between the sample groups.

Test of Homogeneity of Variances

Have you ever received computer training in general?

Levene Statistic	df1	df2	Sig.
71.999	2	99	.000

Table 4.30: ANOVA homogeneity of variances of clinical stakeholders training

A one-way ANOVA is a highly efficient mechanism for performing a completely randomized ANOVA on several groups as illustrated above. An ANOVA controls the overall error by testing all the means against each other at once, so alpha remains at 0.05. The significance value for homogeneity of

variances is < 0.05, so the variances of the groups are significantly different. Table 4.31 is the most important table for ANOVA testing as it illustrates the results from the ANOVA test.

ANOVA

Have you ever received computer training in general?

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.998	2	1.499	6.740	.002
Within Groups	22.021	99	.222		
Total	25.020	101			

Table 431: ANOVA results of clinical stakeholders training

The ANOVA Table 4.31 shows the results of the completely randomized analysis of variance. The significance value in comparing the two groups is 0.02 ($\sigma = 0.02$) which is less than the accepted value of 0.05 ($\rho = 0.05$) meaning that the null hypothesis is rejected. Therefore, it can be concluded that there is a difference between the clinical stakeholders that receive computer training and those that did not.

4.7.2. Using a t-test to analyze the level of exposure to clinical applications

The most commonly used test is the t-test, "which assumes that the two samples are both drawn from normal distributions" (Sloan, 2000). The usual assumption is that the populations have the same variance. The t-test analysis tools test for equality of the population means underlying each sample. The three tools employ different assumptions; that the population variances are equal, that the population variances are not equal, and that the two samples represent before treatment and after treatment observations on the same subjects (SPSS Help, 2010). Table 4.32 and Table 4.33 are the summary and

results table from the t-test analysis. The hypothesis was that the clinical stakeholders have previously had exposure to clinical applications other than in this hospital.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Have you previously had exposure to computerized electronic applications other than in this hospital?	102	.47	.502	.050

Table 4.32: T-test summary of exposure to clinical applications

The t-test summary Table 4.32 illustrates that there were 102 observations (N), the mean number of respondents who had exposure to clinical applications previously is 0.47 and the standard deviation is 0.502. The standard error of the mean (the standard deviation of the sampling distribution of means) is 0.50. This means that more then half of the respondents have had exposure with clinical applications previously and are accustomed to information systems.

One-Sample Test

	Test Value = 0			
	T	df	Sig. (2-tailed)	Mean Difference
Have you previously had exposure to computerized electronic applications other than in this hospital?	9.475	101	.000	.471

Table 4.33: T-test results of exposure to clinical applications

The t-test results table illustrates that the actual t-test value is calculated to be 9.475 ($\tau = 9.475$) and the degrees of freedom is calculated to be 101 (df =101). The fourth column reflects the two-tailed significance but this is not required as this a one-tailed test. The critical t value with 45 degrees of freedom, $\alpha = .05$ and one-tailed is 1.679. The decision rule is that if the one-tailed critical t value is less

than the observed t value and the means are in the right order, then the null hypothesis is rejected. The observed t-test value is 9.475 ($\tau = 9.475$), so H_0 is accepted meaning that clinical stakeholders have previously had exposure to clinical applications other than in this hospital.

Section E of the questionnaire was dedicated to analysing the related knowledge of the current systems that the clinical stakeholders use. The next section further elaborates on the results received pertaining to the perceptions that the clinical stakeholders have regarding their current HIT.

4.7.3. Hypothesis testing: H3

The first step towards testing the H3 hypothesis is to get the adjusted R^2 of the latent factors. The next section discusses this in more detail.

4.7.3.1. Adjusted R^2: H3

The latent factors extracted from the PLS algorithm are the linear combinations of the manifest of the related knowledge responses. Table 4.34 illustrates the extracted the latent factors together with the X variances, Y variances, cumulative X variances, cumulative Y variances and the adjusted R^2.

	Statistics				
Latent Factors	X Variance	Cumulative X Variance	Y Variance	Cumulative Y Variance (R^2)	Adjusted R^2
1	.799	.799	.093	.093	.084
2	.201	1.000	.066	.159	.142

Table 4.34: Adjusted R^2 for H3

All of the R^2 values in Table 4.34 are greater than 0.05 ($R^2 > 0.05$) indicating that the variation of the related knowledge and the variation of the perceived ease of use are important in explaining that the related knowledge of HIT is actually an enabler for perceived ease of use. The next section further elaborates on this by illustrating the PLS weights and loadings analysis gathered from the questionnaire.

4.7.3.2. Latent factor weights: H3

Table 4.35 indicates the independent weights which are the related knowledge, which represents the correlation of the independent variables (related knowledge) with the dependent scores (perceived ease of use).

Weights

Variables	Latent Factors	
	1	2
E5	-.314	.830
E6*	-.949	-.676
D8	.220	.323
D7	.108	.558
D6	.315	.270
D5	.326	.413

* Dropped from further analysis due to low factor loading

Table 4.35: Latent factor weights for H3

The results from Table 4.35 illustrate that factor E6 was dropped from further analysis due to its low factor loading. The remaining independent weights indicate a correlation of greater than 0.4 for the central factor ($\omega > 0.4$) and a correlation of greater than 0.25 ($\omega > 0.25$) for the remaining factors; meaning that there exists a positive correlation between the related knowledge and the scores of the perceived ease of use.

4.7.3.3. Latent factor loadings: H3

Table 4.36 illustrates the independent loading factors which represent the direction of the lines for each independent in X-space. Where the dependent variables are perceived ease of use and the independent variables is related knowledge.

Loadings

Variables	Latent Factors	
	1	2
E5	-.676	.949
E6	-.830	-.314
D8	.546	.552
D7	.189	.437
D6	.585	.572
D5	.584	.570

Table 4.36: Latent factor loading for H3

The loadings achieved in Table 4.36 illustrate a positive direction of independent factors towards the dependent factors having achieved a latent loading of higher than 0.4 ($\lambda > 0.4$). This further indicates a positive relation indicating that the related knowledge is an enabler for perceived ease of use of HIT. Once the loadings and weights have been calculated the next step is to understand the variable importance in projection (VIP) for the dependent variables. This is illustrated in the next section.

4.7.3.4. Variable importance in projection (VIP): H3

Table 4.37 illustrates the VIP coefficients for the independent variables used in testing hypothesis H3 where the independent variables are the related knowledge.

Variable Importance in the Projection

Variables	Latent Factors	
	1	2
E5	.444	.830
E6	1.343	1.197

Table 4.37: Variable importance in projection for H3

The VIP path coefficients conformed to the regression model used for the study by having VIP coefficients larger than 0.8 (VIP > 0.8), indicating a positive projection of related knowledge of HIT as an enabler to perceived ease of use. Having achieved a positive projection in the regression model the final step is to achieve the individual path coefficients of the dependent variables. This is illustrated in the next and final section of testing hypothesis H3.

4.7.3.5. Path coefficient: H3

The final step in testing hypothesis H3 is to calculate the individual path coefficients for the dependent variables, namely the perceived ease of use factors. Table 4.38 illustrates the path coefficients for the perceived ease of use variables.

Parameters

Independent Variables	Dependent Variables			
	D8	D7	D6	D5
(Constant)	3.499	3.561	3.789	3.857
E5	.269	1.991	.196	.378
E6	-.506	-1.947	-.659	-.810

Table 4.38: Path coefficients for H3

The individual path coefficients of the dependent variables indicated a positive result, were D5 has the highest path coefficient of 3.857 ($\beta = 3.857$) and the lowest path coefficient being D8 which is 3.499 ($\beta = 3.499$). The mean of the dependent path coefficient is, therefore, calculated to be 3.677 ($\beta = 3.677$). The hypothesis H3 is therefore accepted due to the following empirical calculated support:

- Adjusted R_2 is greater than 0.05 ($R_2 > 0.05$)
- The latent factor weights have a correlation factor greater than 0.4 ($\omega > 0.4$) for the central factor and a correlation of greater than 0.25 ($\omega > 0.4$) for the remaining correlation factors
- The latent factor loading achieved is higher than 0.4 ($\lambda > 0.4$) indicating a positive relation of related knowledge towards perceived ease of use
- VIP coefficients achieved are larger than 0.8 (VIP > 0.8) indicating a positive projection of related knowledge of HIT being an enabler of perceived ease of use

- The individual path coefficients for the dependent variables are positive in nature indicating that the independent variables (related knowledge) can be used to determine the dependent variables (perceived ease of use). The mean path coefficients for the dependent variables are 3.677 ($\beta = 3.677$).

The findings above confirm hypothesis H3 and illustrate that related knowledge has a strong and significant positive effect on perceived ease of use. The next section discusses the perceived ease of use of clinical applications and tests the hypothesis that perceived ease of use is indeed an enabler to the intended use of HIT by clinical stakeholders.

4.8. Perceived ease of use

Perceived ease of use (PEOU) is defined as "the extent to which users believe that their system usage will be relatively free of effort" (Davis *et al.,* 1989). The minimum requirement for a system that is implemented to be perceived as easy to use is to be able to achieve the same results as before but with less effort. This in turn means that if a system requires much more effort in achieving the same results as previously achieved then the system is deemed as non-beneficial and subsequently leads to lack of confidence in the system which ultimately leads to a lack of system usage. Therefore, the following hypothesis is put forward:

H4: The perceived ease of use of HIT by clinical stakeholders is an enabler to their intention to use HIT.

In determining the perceived ease of use of clinical applications in a paperless environment, the respondents were asked several questions to understand whether or not the clinical applications in a

paperless environment would be beneficial to them in improving their own tasks. A five point Likert scale was used ranging from “Strongly Agree” to “Strongly Disagree”. The research model indicates that perceived usefulness is an enabler to the intention to use HIT, meaning that if the user perceives the technology easy to use the greater the likelihood of the user accepting the system. Figure 4.8 illustrates the respondents’ perceived ease of use of clinical applications in a paperless environment.

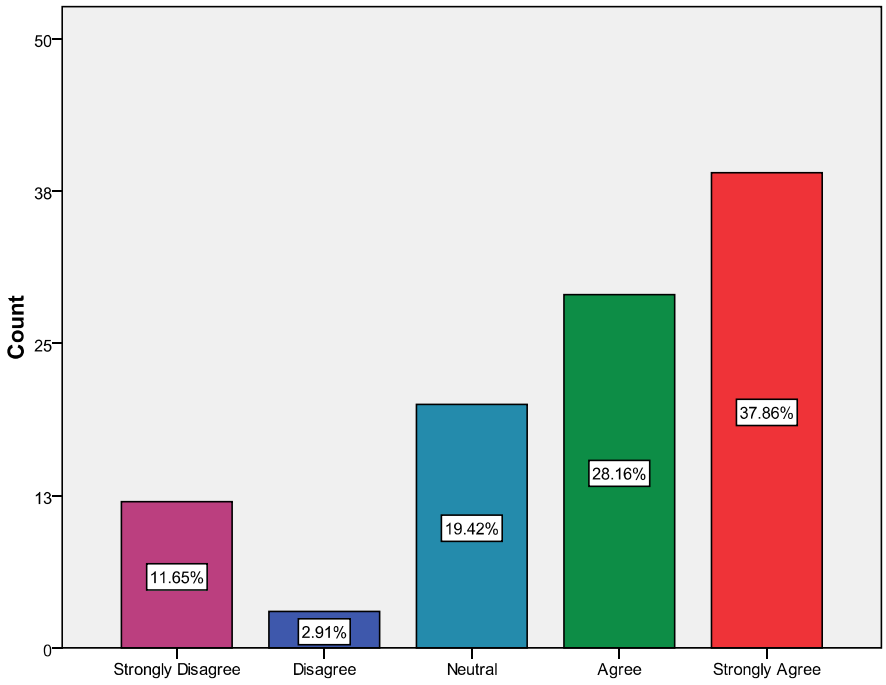

Figure 4.8: Perceived ease of use of clinical applications in hospital

The results indicated that 37.86% and 28.16% of the respondents either “Strongly Agree” or “Agree” respectively that the clinical applications in a paperless hospital are perceived to be easy to use. A figure of 2.91% and 11.86% respectively indicated that they do not perceive the clinical applications to be easy to use in a paperless environment. Having a better understanding and greater knowledge of the system would help the clinical stakeholders in knowing the benefits of the system.

4.8.1. Hypothesis testing: H4

The first step towards testing the H4 hypothesis is to get the adjusted R^2 of the latent factors. The next section discusses this in more detail.

4.8.1.1. Adjusted R^2: H4

In determining whether the perceived ease of use of clinical applications is an enabler for their intention to use, the intention to use responses were chosen as the dependent variables and the perceived ease of use were then the independent variables in the PLS algorithm. Table 4.39 illustrates the extracted latent factors together with the X variances, Y variances, cumulative X variances, cumulative Y variances and the adjusted R^2.

Proportion of Variance Explained

	Statistics				
Latent Factors	X Variance	Cumulative X Variance	Y Variance	Cumulative Y Variance (R^2)	Adjusted R^2
1	.698	.698	.193	.193	.185
2	.245	.943	.036	.229	.213
3	.044	.987	.049	.278	.256
4	.013	1.000	.009	.287	.257

Table 4.39: Adjusted R^2: H4

All of the R^2 values above are greater than 0.05 ($R^2 > 0.05$) indicating that the variation of the perceived ease of use and the variation of the intention to use HIT is important in explaining that perceived ease of use of HIT is actually an enabler for intention to use HIT. The next section further elaborates on this by illustrating the PLS weights and loadings analysis gathered from the questionnaire.

4.8.1.2. Latent factor weights: H4

Table 4.40 indicates the independent weights which are the perceived ease of use, which represents the correlation of the independent variables (perceived ease of use) with the dependent scores (intention to use).

Weights

Variables	Latent Factors			
	1	2	3	4
D5	.550	.016	-.434	-.703
D6	.536	-.039	-.380	.712
D7*	-.047	-.993	.089	-.011
D8	.638	.191	.818	-.006
C11	.235	.362	.196	-.254
C10	.425	.363	.017	-.991
C9*	-.340	.217	-.859	.385
C8	.164	.187	-.445	.069
C7	.243	-.003	-.552	-.228
C6	.286	.107	.576	.008
C5	.285	.103	.503	.327
C4	.260	.119	.660	.002
C3	.215	.082	.471	.442
C2	.223	.110	.489	.569
C1	.133	.093	.528	-.041

* Dropped from further analysis due to low factor loading

Table 4.40: Latent factor weights for H4

The results from Table 4.40 illustrate that factors C9 and D7 were dropped from further analysis due to their low factor loading. The remaining independent weights indicate a correlation of greater than 0.4 for the central factor ($\omega > 0.4$) and a correlation of greater than 0.25 ($\omega > 0.25$) for the remaining factors

meaning there exists a positive correlation between the perceived ease of use and the scores of the intention to use HIT.

4.8.1.3. Latent factor loadings: H4

Table 4.41 illustrates the independent loading factors which represent the direction of the lines for each independent in X-space where the dependent variables are intention to use HIT and the independent variables are perceived ease of use.

Loadings

Variables	Latent Factors			
	1	2	3	4
D5	.588	-.061	-.450	-.686
D6	.587	-.075	-.435	.726
D7	.097	-.997	.157	-.044
D8	.574	.042	.765	-.022
C11	.281	.400	.228	-.219
C10	.327	.318	.111	-.254
C9*	-.098	.237	-.105	.414
C8	.267	.394	.141	.469
C7	.341	.394	.280	.374
C6	.380	.421	.541	.598
C5	.383	.435	.535	.609
C4	.361	.375	.543	.728
C3	.389	.472	.607	.717
C2	.348	.379	.546	.815
C1	.349	.433	.631	.688

Table 4.41: Latent factor loading for H4

The loadings achieved above illustrate a positive direction of independent factors towards the dependent factors, having achieved a latent loading of higher than 0.4 ($\lambda > 0.4$). This further indicates a positive relation indicating that the perceived ease of use is an enabler for intention to use HIT. Once the loadings and weights have been calculated the next step is to understand the variable importance in projection (VIP) for the dependent variables. This is illustrated in the next section.

4.8.1.4. Variable importance in projection: H4

Table 4.42 illustrates the VIP coefficients for the independent variables used in testing hypothesis H4 where the independent variables are the perceived ease of use.

Variable Importance in the Projection

Variables	Latent Factors			
	1	2	3	4
D5	1.100	1.009	.986	1.001
D6	1.073	.985	.949	.967
D7*	.095	.795	.726	.714
D8	1.277	1.181	1.273	1.254

Table 4.42: Variable importance in projection for H4

Factor D7 in Table 4.22 was dropped from the model due to a low VIP coefficient (VIP < 0.8). The remaining VIP path coefficients conform to the regression model used for the study by having VIP coefficients larger than 0.8 (VIP > 0.8), indicating a positive projection of perceived ease of use of HIT as an enabler for intention to use. Having achieved a positive projection in the regression model the final step is to achieve the individual path coefficients of the dependent variables. This is illustrated in the next and final section of testing hypothesis H4.

4.8.1.5. Path coefficient: H4

The final step in testing hypothesis H4 is to calculate the individual path coefficients for the dependent variables, namely the perceived usefulness factors. Table 4.43 illustrates the path coefficients for the intention to use HIT variables.

Parameters

Independent Variables	Dependent Variables										
	C11	C10	C9	C8	C7	C6	C5	C4	C3	C2	C1
(Constant)	1.430	.926	8.758	1.466	1.668	1.385	1.334	1.459	1.506	1.721	1.754
D5	.236	.869	-.156	.280	.578	-.087	-.281	-.129	-.382	-.396	-.111
D6	-.148	-.469	.793	.353	.194	-.058	.186	-.104	.241	.273	-.145
D7	-.122	-.117	-.182	-.093	-.020	-.021	-.024	-.022	-.018	-.023	-.015
D8	.457	.392	-1.964	-.307	-.372	.704	.688	.762	.600	.528	.552

Table 4.43: Path coefficients for H4

The individual path coefficients of the dependent variables indicated a positive result, where C1 has the highest path coefficient of 1.754 ($\beta = 1.754$) and the lowest path coefficient being C10 which is 0.926 ($\beta = 0.926$). The mean of the dependent path coefficient is, therefore, calculated to be 2.13 ($\beta = 2.13$). The null hypothesis H4 is therefore accepted due to the following empirical calculated support:

- Adjusted R_2 is greater than 0.05 ($R_2 > 0.05$)
- The latent factor weights has a correlation factor greater than 0.4 ($\omega > 0.4$) for the central factor and a correlation of greater than 0.25 ($\omega > 0.4$) for the remaining correlation factors
- The latent factor loading achieved is higher than 0.4 ($\lambda > 0.4$) indicating a positive relation of perceived ease of use towards intention to use

- VIP coefficients achieved are larger than 0.8 (VIP > 0.8) indicating a positive projection of perceived ease of use of HIT being an enabler of intention to use HIT
- The individual path coefficients for the dependent variables are positive in nature indicating that the independent variable (perceived ease of use) can be used to determine the dependent variable (intention to use HIT). The mean path coefficients for the dependent variable are 2.13 ($\beta = 2.13$).

The findings above confirm hypothesis H4 and illustrates that perceived ease of use has a strong and significant positive effect on intention to use HIT. The one exception, however, is the writing of clinical prescriptions for patients. This analysis did not include the nurses as nurses are not allowed to give out prescriptions. The doctors indicated that this could be more time efficient to rather write out the prescription rather than use a clinical application. Figure 4.9 depicts the responses received for using clinical applications to write prescriptions by doctors.

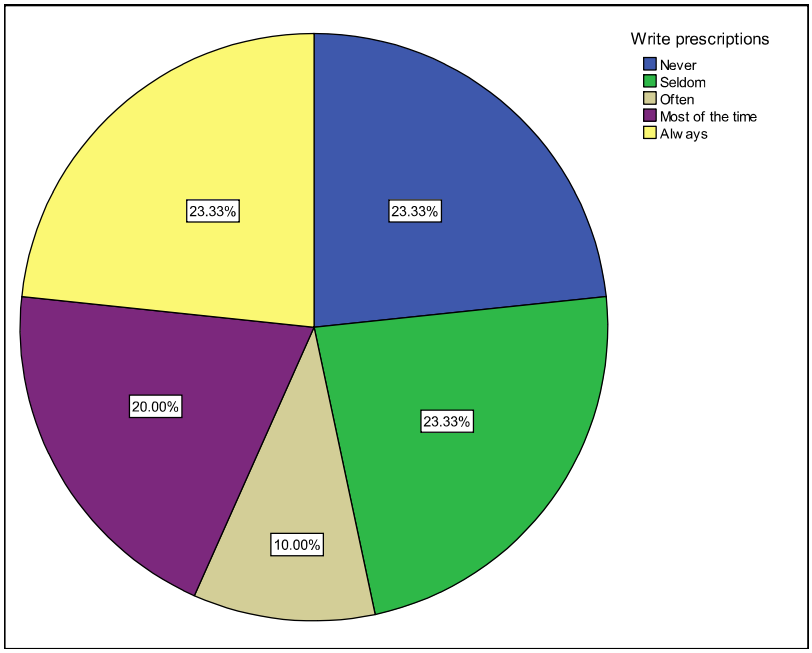

Figure 4.9: Use of clinical applications to write prescriptions by doctors

The pie chart above indicates that 23.33% of the respondents would “Never” use clinical applications to write prescriptions while 23.33% of the respondents would “Seldom” use clinical applications to write prescriptions. This does indicate a tendency by the clinical stakeholders to still prefer the hand written process of writing out prescriptions. This also indicates that the clinical stakeholders do not perceive the clinical applications to write prescriptions as easy to use or useful and a possible reason for this could be that it is quicker to write out the prescription by hand than to use a the computer. The next section discusses the perceived threat of clinical applications and tests the hypothesis that perceived threat is indeed an enabler to the resistance to change of HIT by clinical stakeholders.

4.9. Perceived threat

There are many advantages of HIT in healthcare ranging from reducing cost, improving patient care, improving efficiency to automated processes and real time patient analysis. “Insufficient user acceptance has long been an obstacle to the successful adoption of new information systems and information technologies within the healthcare sector” (Legris *et al.*, 2001). While IT in other sectors continues to rapidly evolve and transform, it is extremely important to understand the reason clinical stakeholders felt threatened by the introduction of information technology.

There are several explanations as to why clinical stakeholders felt threatened by information technology. Researchers such as Samaha (2003), Parente (2003), Laurem *et al.* (2004), and Dansky *et al.* (1994) have suggested a number of reasons explaining why information technology is perceived as a threat. Some of these reasons include; the introduction approach of HIT in an organization, education, computer training, and organization culture. Bhattacherjee and Hikmet (2007) further elaborate on the reasons for the perceived threat in their study of clinical stakeholders resistance by stating that “rarely do individuals form resistant attitudes, or express such attitudes in acts of dissent or protest, without

considering the potential negative consequences for themselves; in other words, people resist change if they expect it to threaten the status quo, such as a potential loss of power or control over strategic organizational resources." Therefore the following hypothesis is put forward:

H5: *The perceived threat of HIT by clinical stakeholders is an enabler to their resistance to use HIT.*

Section F of the questionnaire was dedicated to analysing the perceived threat that the clinical stakeholders have towards clinical applications. A five point Likert scale was used to determine whether or not the respondents felt threatened to work in a paperless environment.

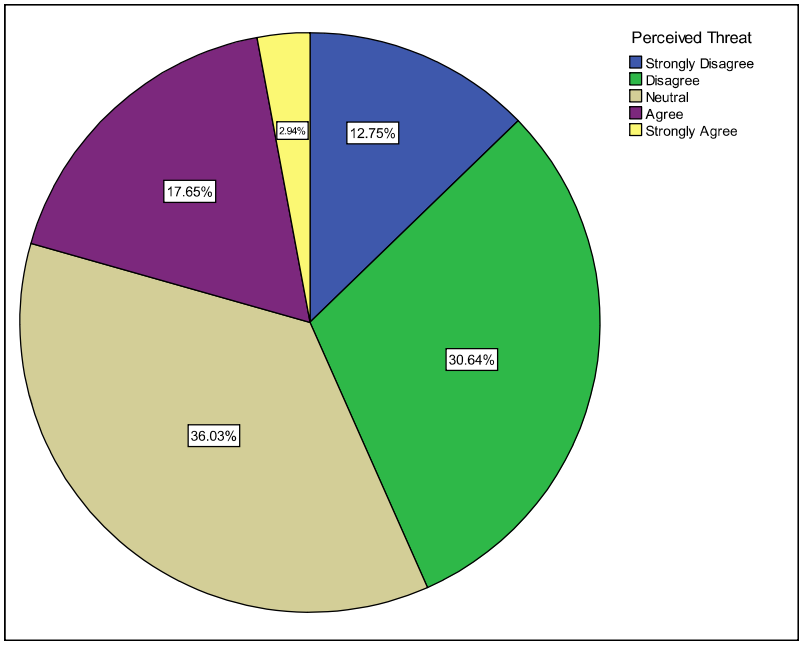

Figure 4.10: Perceived threat of clinical applications in hospital

Figure 4.10 illustrates that most of the respondents (30.64%) disagreed that working in a paperless environment will make the clinical stakeholders feel threatened, while a few, (17.65%) of the

respondents were in agreement that clinical stakeholders would feel threatened in a paperless environment. This indicates that because the clinical stakeholders felt threatened by the information technology, they would subsequently be resistant to the change of working in a paperless environment.

4.9.1. Hypothesis testing: H5

The first step towards testing the H5 hypothesis is to get the adjusted R^2 of the latent factors. The next section discusses this in more detail.

4.9.1.1. Adjusted R^2: H5

In determining if the perceived threat of HIT implementations is an enabler for clinical stakeholders resistance to change towards HIT, the resistance to change responses were chosen as the dependent variables and the perceived threat were then the independent variables in the PLS algorithm. The latent factors extracted from the PLS algorithm are the linear combinations of the manifest of the perceived threat responses. Table 4.44 illustrates the extracted latent factors together with the X variances, Y variances, cumulative X variances, cumulative Y variances and the adjusted R^2.

Proportion of Variance Explained

	Statistics				
Latent Factors	X Variance	Cumulative X Variance	Y Variance	Cumulative Y Variance (R^2)	Adjusted R^2
1	.930	.930	.199	.199	.191
2	.051	.981	.011	.209	.193
3	.017	.999	.015	.224	.200
4	.001	1.000	.029	.253	.222

Table 4.44: Adjusted R^2 for H5

All of the R^2 values above are greater than 0.05 ($R^2 > 0.05$) indicating that the variation of the perceived threat and the variation of the resistance to change are important in explaining that perceived threat of HIT is actually an enabler for resistance to change. The next section further elaborates on this by illustrating the PLS weights and loadings analysis gathered from the questionnaire.

4.9.1.2. Latent factor weights: H5

Table 4.45 indicates the independent weights which are the perceived threat, which represents the correlation of the independent variable (perceived threat) with the dependent scores (resistance to change).

Weights

Variables	Latent Factors			
	1	2	3	4
F1	.478	.409	-.547	.031
F2	.529	.238	.497	-.578
F3	.466	-.858	-.619	-.316
F4	.524	.203	.611	.850
G4	.175	-.165	.041	-1.842
G3	.126	-.141	.363	-1.876
G2	.299	.329	.488	2.579
G1	.279	.349	.725	2.580

Table 4.45: Latent factor weights for H5

The results from Table 4.45 illustrate that no factors were dropped from the analysis due to their high factor loading. The independent weights indicate a correlation of greater than 0.4 for the central factor ($\omega > 0.4$) and a correlation of greater than 0.25 ($\omega > 0.25$) for the remaining factors meaning there exists a positive correlation between the perceived threat and the scores of the resistance to change.

4.9.1.3. Latent factor loadings: H5

Table 4.46 illustrates the independent loading factors which represent the direction of the lines for each independent in X-space were the independent factors are perceived threat.

Loadings

Variables	Latent Factors			
	1	2	3	4
F1	.481	.807	-.800	.085
F2	.512	.166	.531	-.737
F3	.493	-.784	-.156	-.005
F4	.514	-.208	.332	.671
G4	.496	.360	.568	-.226
G3	.490	.437	.614	-.184
G2	.546	.922	.567	.690
G1	.540	.986	.585	.758

Table 4.46: Latent factor loading for H5

The loadings achieved above illustrate a positive direction of independent factors towards the dependent factors having achieved a latent loading of higher than 0.4 ($\lambda > 0.4$). This further indicates a positive relation indicating that the perceived threat is an enabler for resistance to change of clinical stakeholders in using HIT. Once the loadings and weights have been calculated the next step is to understand the variable importance in projection (VIP) for the dependent variables. This is illustrated in the next section.

4.9.1.4. Variable importance in projection: H5

Table 4.47 illustrates the VIP coefficients for the independent variables used in testing hypothesis H5 where the dependent variables are resistance to change and the independent variables are perceived threat.

Variable Importance in the Projection

Variables	Latent Factors			
	1	2	3	4
F1	.956	.950	.960	.903
F2	1.058	1.037	1.034	1.049
F3	.932	.986	1.005	.969
F4	1.048	1.025	1.039	1.135

Table 4.47: Variable importance in projection for H5

The VIP path coefficients conformed to the regression model used for the study by having VIP coefficients larger than 0.8 (VIP > 0.8), indicating a positive projection of perceived threat of HIT as an enabler to resistance to change. Having achieved a positive projection in the regression model the final step is to achieve the individual path coefficients of the dependent variables. This is illustrated in the next and final section of testing hypothesis H5.

4.9.1.5. Path coefficient: H5

The final step in testing hypothesis H5 is to calculate the individual path coefficients for the dependent variables, namely the perceived threat factors. Table 4.48 illustrates the path coefficients for the perceived threat variables.

Independent Variables	Dependent Variables			
	G4	G3	G2	G1
(Constant)	2.112	2.153	1.282	1.335
F1	-.064	-.274	.109	-.048
F2	1.064	1.274	-1.109	-.952
F3	.740	.546	-1.403	-1.540
F4	-1.426	-1.350	3.060	3.103

Table 4.48: Path coefficients for H5

The individual path coefficients of the dependent variables indicate a positive result, where G3 has the highest path coefficient of 2.153 ($\beta = 2.153$) and the lowest path coefficient being G2 which is 1.282 ($\beta = 1.282$). The mean of the dependent path coefficient is, therefore, calculated to be 1.72 ($\beta = 1.72$). The hypothesis H5 is, therefore, accepted due to the following empirical calculated support:

- Adjusted R_2 is greater than 0.05 ($R_2 > 0.05$)
- The latent factor weights have a correlation factor greater than 0.4 ($\omega > 0.4$) for the central factor and a correlation of greater than 0.25 ($\omega > 0.4$) for the remaining correlation factors
- The latent factor loading achieved is higher than 0.4 ($\lambda > 0.4$) indicating a positive relation of perceived threat towards resistance to change
- VIP coefficients achieved are larger than 0.8 (VIP > 0.8) indicating a positive projection of perceived threat of HIT being an enabler of resistance to change
- The individual path coefficients for the dependent variables are positive in nature indicating that the independent variables (perceived threat) can be used to determine the dependent variables (resistance to change). The mean path coefficients for the dependent variables are 1.72 ($\beta = 1.72$).

The findings above confirm hypothesis H5 and illustrates that perceived threat has a strong and significant positive effect on resistance to change. The next section discusses the resistance to change by clinical stakeholders in using HIT applications.

4.10. Resistance to change

The introduction of HIT in hospitals is implemented to improve both the quality and efficiency of health care delivery, which in turn means a particular change in the way one will go about doing their daily activities. Changes are not necessarily easy to achieve in any sector and in the health care sector with the potential life and death situations, changes might be particularly hard to achieve which results in a lack of acceptance by the clinical stakeholders of the information technology.

A reason for this lack of acceptance could be attributed to human behavior within the health care sector. Bhattacherjee and Hikmet (2007) mentioned that “when inhibitors to system usage are present they tend to anchor one’s overall perception towards attitude objects, subsequently biasing all other perceptions, including those of enablers. For instance, a single instance of system failure may lead clinical stakeholders to view the target HIT as being of overall poor quality, despite more frequent instances of adequate system functioning or its multitude of positive features and capabilities.”

In determining the resistance to change of clinical stakeholders, the respondents were asked several questions to understand whether or not they will resist working in a paperless environment. A five point Likert scale was used with answers ranging from “Strongly Agree” to “Strongly Disagree”. The research model indicates that resistance to change is an inhibitor to perceived usefulness, perceived ease of use

and intention to use HIT. Figure 4.11 illustrates the respondent's resistance towards a paperless environment.

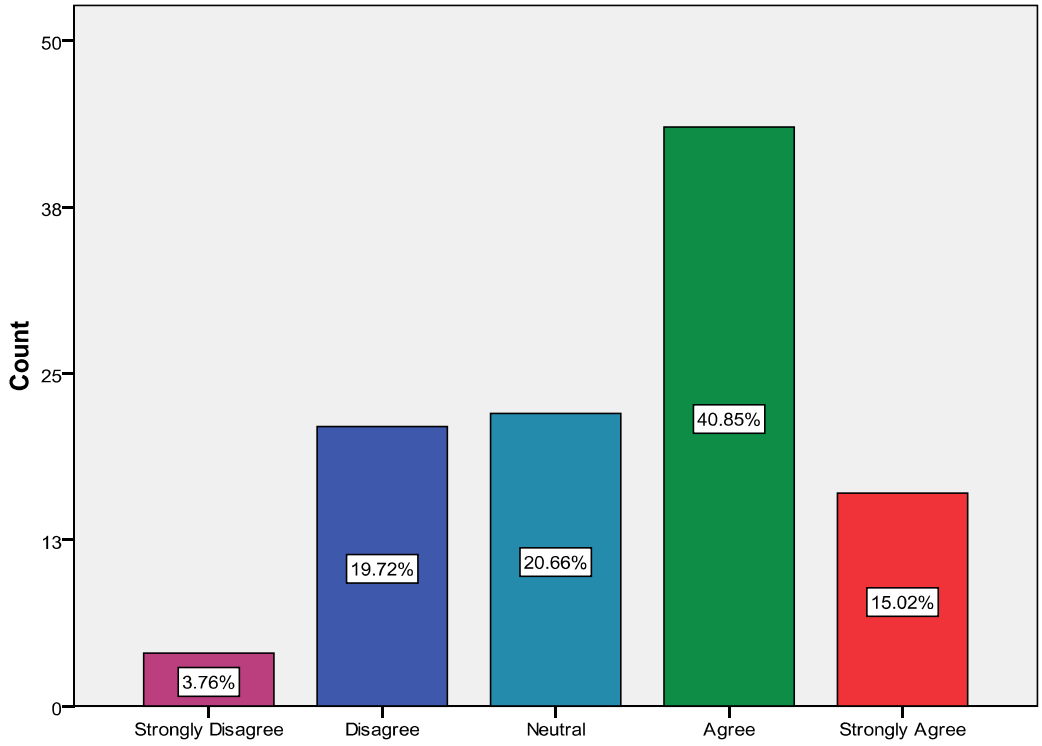

Figure 4.11: Resistance to change towards clinical applications in hospital

Figure 4.11 illustrates that 40.85% of the respondents "Agree" that the introduction of clinical applications in a paperless environment should not change the way the clinical stakeholders currently go about their daily activities whilst only 3.78% of the respondents would actually want the clinical applications to change their daily activities. This indicates that another of the barriers that contributes to the lack of system usage is the organizational culture and the resistance to change.

Health care professionals need sufficient ICT skills in order to maximize the full benefits of information technologies available at the hospitals. “The amount of health care information being made available, together with the issues arising around how appropriate available information is to user needs, means that health care professionals need the necessary skills to search for the information that meet their requirements” (Parente, 2003). Therefore, providing the health care stakeholders with the necessary skills will enable them to become experts at the system and perceives the technology as both useful and easy to use. A lack of knowledge of the benefits that HIT brings normally tends to be an enabler for the resistance to IT and leads to limited HIT usage. Given that resistance is clearly a contributing factor to the usage of HIT; the following two hypotheses can be put forward:

H6: Clinical stakeholders’ resistance to change is an inhibitor to their perceived usefulness to use HIT.

H7: Clinical stakeholders’ resistance to change is an inhibitor to their perceived ease of use to HIT.

4.10.1. Hypothesis testing: H6 & H7

The first step towards testing hypotheses H6 and H7 is to get the adjusted R^2 of the latent factors. The next section discusses this in more detail.

4.10.1.1. Adjusted R^2: H6 & H7

In determining if clinical stakeholders resistance to change is an inhibitor to both perceived ease of use and perceived use, both the perceived usefulness and perceived ease of use responses were chosen as the dependent variables and the resistance to change was then the independent variable in the PLS algorithm. Table 4.49 and Table 4.50 illustrate the extracted latent factors together with the X variances, Y variances, cumulative X variances, cumulative Y variances and the adjusted R^2.

Proportion of Variance Explained

Latent Factors	Statistics				
	X Variance	Cumulative X Variance	Y Variance	Cumulative Y Variance (R^2)	Adjusted R^2
1	.847	.847	.207	.207	.199
2	.133	.980	.101	.308	.294
3	.015	.995	.018	.327	.306
4	.005	1.000	.007	.334	.307

Table 4.49: Adjusted R^2 for H6

Proportion of Variance Explained

Latent Factors	Statistics				
	X Variance	Cumulative X Variance	Y Variance	Cumulative Y Variance (R^2)	Adjusted R^2
1	.830	.830	.117	.117	.108
2	.151	.980	.142	.259	.244
3	.006	.986	.017	.276	.254
4	.014	1.000	.004	.280	.250

Table 4.50: Adjusted R^2 for H7

All of the R^2 values in Table 4.49 are greater than 0.05 ($R^2 > 0.05$) indicating that the variation of the resistance to change and the variation of the perceived usefulness are important in explaining that resistance to change of HIT is actually an inhibitor for perceived usefulness. In the same way, Table 4.50 indicates that the variation of the resistance to change and the variation of the perceived ease of use are important in explaining that resistance to change of HIT is actually an inhibitor for perceived ease of use. The next section further elaborates on this by illustrating the PLS weights and loadings analysis gathered from the questionnaire.

4.10.1.2. Latent factor weights: H6 & H7

Table 4.51 and Table 4.52 indicate the independent weights which is the resistance to change, which represents the correlation of the independent variable (resistance to change) with the dependent scores (perceived usefulness and perceived ease of use).

Weights

Variables	Latent Factors			
	1	2	3	4
G1	.656	.582	.392	.606
G2	.609	.392	-.410	-.639
G3	.331	-.480	.602	-.323
G4	.298	-.598	-.575	.362
D4	.196	.430	-.122	.972
D3	.241	.357	.613	-.248
D2	.281	.464	.434	.253
D1	.298	.495	.822	.587

Table 4.51: Latent factor weights for H6

Weights

Variables	Latent Factors			
	1	2	3	4
G1	.708	.575	.659	.043
G2	.645	.424	-.693	-.031
G3	.197	-.599	-.189	.725
G4	.208	-.573	.230	-.733
D8	.122	.694	.467	.042
D7	.157	.144	.459	.368
D6	.246	.467	1.547	-.368
D5	.263	.471	.570	.125

Table 4.52: Latent factor weights for H7

The independent weights in both Tables above indicate a correlation of greater than 0.4 for the central factor ($\omega > 0.4$) and a correlation of greater than 0.25 ($\omega > 0.25$) for the remaining factors meaning there exists a positive correlation between:

- The resistance to change and the scores of the perceived usefulness
- The resistance to change and the scores of the perceived ease of use usefulness.

4.10.1.3. Latent factor loadings: H6 & H7

Table 4.53 and Table 4.54 illustrate the independent loading factors which represent the direction of the lines for each independent in X-space.

Loadings

Variables	Latent Factors			
	1	2	3	4
G1	.544	.344	.273	.554
G2	.547	.287	-.399	-.611
G3	.491	-.637	.688	-.364
G4	.494	-.637	-.549	.432
D4	.494	.525	.652	.822
D3	.508	.516	.685	.777
D2	.510	.495	.632	.719
D1	.508	.483	.615	.683

Table 4.53: Latent factor loading for H6

Loadings

Variables	Latent Factors			
	1	2	3	4
G1	.588	.225	.676	.203
G2	.590	.178	-.775	-.215
G3	.500	-.685	.016	.682
G4	.504	-.672	.088	-.669
D8	.543	.610	.588	-.375
D7	.263	.123	.215	1.195
D6	.597	.568	.671	-.441
D5	.596	.561	.637	-.388

Table 4.54: Latent factor loading for H7

The loadings achieved in both tables above illustrate a positive direction of independent factors towards the dependent factors having achieved a latent loading of higher than 0.4 ($\lambda > 0.4$). This further indicates that there exists a:

- Positive relationship indicating that the resistance to change is an inhibitor towards perceived usefulness of HIT
- Positive relationship indicating that the resistance to change is an inhibitor towards perceived ease of use of HIT.

Once the loadings and weights have been calculated the next step is to understand the variable importance in projection (VIP) for the dependent variables. This is illustrated in the next section.

4.10.1.4. Variable importance in projection: H6 & H7

Table 4.55 and Table 4.56 illustrate the VIP coefficients for the independent variable used in testing hypotheses H6 and H7 are the independent variables being perceived usefulness and perceived ease of use respectively.

Variable Importance in the Projection

Variables	Latent Factors			
	1	2	3	4
G1	1.312	1.266	1.244	1.243
G2	1.218	1.095	1.081	1.086
G3	.662	.773	.803	.800
G4	.597	.842	.862	.859

Table 4.55: Variable importance in projection for H6

Variable Importance in the Projection

Variables	Latent Factors			
	1	2	3	4
G1	1.417	1.278	1.280	1.271
G2	1.290	1.071	1.093	1.085
G3	.393	.925	.901	.911
G4	.416	.893	.872	.883

Table 4.56: Variable importance in projection for H7

The VIP path coefficients in both Tables above conform to the regression model used for the study by having VIP coefficients larger than 0.8 (VIP > 0.8), indicating:

- A positive projection of resistance to change towards HIT is an inhibitor to perceived usefulness

- A positive projection of resistance to change towards HIT is an inhibitor to perceived ease of use.

Having achieved a positive projection in the regression model the final step is to achieve the individual path coefficients of the dependent variables. This is illustrated in the next and final section of testing hypothesis H6 and H7.

4.10.1.5. Path coefficient: H6 & H7

The final step in testing hypothesis H6 and H7 is to calculate the individual path coefficients for the dependent variables, namely the perceived usefulness and perceived ease of use factors. Table 4.57 and Table 4.58 illustrate the path coefficients for the resistance to change variables.

Parameters

Independent Variables	Dependent Variables			
	D4	D3	D2	D1
(Constant)	1.856	1.719	1.620	1.469
G1	1.134	.557	.900	1.357
G2	-.336	.229	.015	-.380
G3	-.700	.470	.061	.209
G4	.310	-.806	-.459	-.617

Table 4.57: Path coefficients for H6

Parameters

Independent Variables	Dependent Variables			
	D8	D7	D6	D5
(Constant)	2.999	1.504	1.624	1.884
G1	.843	1.861	1.770	1.033
G2	.049	-.586	-.831	-.035
G3	-.512	.488	-1.040	-.328
G4	-.354	-.877	.566	-.245

Table 4.58: Path coefficients for H7

The individual path coefficients of the dependent variables in both Tables above indicate a positive result. The mean of the dependent path coefficient in Table 4.57 is calculated to be 1.66 ($\beta = 1.66$) while the dependent path coefficient in Table 4.58 is calculated to be 2.00 ($\beta = 2.00$). The hypotheses H6 and H7 are, therefore, accepted due to the following empirical calculated support:

- Adjusted R_2 is greater than 0.05 ($R_2 > 0.05$)
- The latent factor weights have a correlation factor greater than 0.4 ($\omega > 0.4$) for the central factor and a correlation of greater than 0.25 ($\omega > 0.4$) for the remaining correlation factors
- The latent factor loading achieved is higher than 0.4 ($\lambda > 0.4$) indicating a positive relation of resistance to change towards perceived usefulness
- The latent factor loading achieved is higher than 0.4 ($\lambda > 0.4$) indicating a positive relation of resistance to change towards perceived ease of use
- VIP coefficients achieved are larger than 0.8 (VIP > 0.8) indicating a positive projection of resistance of change of HIT being an inhibitor of perceived usefulness

- VIP coefficients achieved are larger than 0.8 (VIP > 0.8) indicating a positive projection of resistance of change of HIT being an inhibitor of perceived ease of use
- The individual path coefficients for the dependent variables are positive in nature indicating that the independent variable (resistance to change) can be used to determine the dependent variables (perceived usefulness and perceived ease of use). The mean path coefficients for the dependent variables are 1.66 ($\beta = 1.66$) and 2.00 ($\beta = 2.00$) respectively.

The findings above confirm hypotheses H6 and H7 and illustrate that resistance to change has a strong and significant, negative effect on perceived usefulness and perceived ease of use. The next section discusses the resistance to change as also an inhibitor towards clinical stakeholders' intention to use HIT.

The question then remains as to why there is resistance to information technology and particularly within the healthcare sector. Bhattacherjee and Hikmet (2007) state that if the level of change is a significant one, then, given that humans naturally have the tendency to oppose change, then this will lead to many users resisting the change which eventually leads to a lack of HIT usage. Therefore, the following hypothesis is put forward:

H8: Clinical stakeholders' resistance to change is an inhibitor to their intention to use HIT.

4.10.2. Hypothesis testing: H8

The first step towards testing the H8 hypothesis is to get the adjusted R^2 of the latent factors. The next section discusses this in more detail.

4.10.2.1. Adjusted R^2: H8

In determining if clinical stakeholders' resistance to change is an inhibitor to intention to use HIT, the intention to use HIT responses was chosen as the dependent variables. Table 4.59 illustrates the extracted latent factors together with the X variances, Y variances, cumulative X variances, cumulative Y variances and the adjusted R^2.

Proportion of Variance Explained

	Statistics				
Latent Factors	X Variance	Cumulative X Variance	Y Variance	Cumulative Y Variance (R^2)	Adjusted R^2
1	.837	.837	.019	.019	.009
2	.143	.980	.066	.085	.067
3	.013	.993	.133	.218	.194
4	.007	1.000	.047	.265	.235

Table 4.59: Adjusted R^2 for H8

All of the R^2 values above are greater than 0.05 ($R^2 > 0.05$) indicating that the variation of the intention to use HIT and the variation of the resistance to change is important in explaining that resistance to change of HIT is actually an inhibitor for intention to use. The next section further elaborates on this by illustrating the PLS weights and loadings analysis gathered from the questionnaire.

4.10.2.2. Latent factor weights: H8

Table 4.60 indicates the independent weight which represents the correlation of the independent variable (resistance to change) with the dependent scores (intention to use).

Weights

Variables	Latent Factors			
	1	2	3	4
G1	-.639	-.491	.645	.548
G2*	-.686	-.503	-.661	-.581
G3	-.228	.587	.286	-.511
G4	-.262	.553	-.260	.549
C11	-.060	-.161	1.253	1.686
C10*	-.082	-.364	1.697	-.106
C9	.142	.917	1.514	.633
C8	-.020	.205	.701	1.105
C7	-.146	.185	1.705	1.107
C6	.017	.088	2.165	1.129
C5	.029	.014	2.216	2.031
C4	.015	-.306	1.919	1.379
C3	.038	.081	2.141	1.641
C2	.037	-.279	2.083	.985
C1	.126	.091	1.558	1.110

* Dropped from further analysis due to low factor loading

Table 4.60: Latent factor weights for H8

The results from Table 4.60 illustrate that factors G2 and C10 were dropped from further analysis due to their low factor loading. The remaining independent weights indicate a correlation of greater than 0.4 for the central factor ($\omega > 0.4$) and a correlation of greater than 0.25 ($\omega > 0.25$) for the remaining factors meaning there exists a positive correlation between the resistance to change and the scores of the intention to use.

4.10.2.3. Latent factor loadings: H8

Table 4.61 illustrates the independent loading factors which represent the direction of the lines for each independent in X-space where the independent variable is the resistance to change.

Loadings

Variables	Latent Factors			
	1	2	3	4
G1	-.568	-.266	.562	.262
G2	-.573	-.225	-.499	-.283
G3	-.495	.672	.568	-.644
G4	-.500	.654	-.558	.660
C11	-.453	-.340	.234	.260
C10	-.584	-.447	.267	.247
C9	.693	.832	.012	-.069
C8	-.066	.073	.266	.326
C7	-.205	-.044	.332	.346
C6	.130	-.224	.368	.375
C5	.125	-.217	.373	.381
C4	.137	-.347	.351	.362
C3	.215	-.198	.386	.402
C2	.192	-.324	.342	.344
C1	.324	-.197	.349	.383

Table 4.61: Latent factor loading for H8

The loadings achieved in Table 4.61 illustrate a negative direction of independent factors towards the dependent factors having achieved a latent loading of lower than 0.4 ($\lambda > 0.4$). This further indicates a negative relation indicating that resistance to change is an inhibitor for intention to use HIT. Once the loadings and weights have been calculated the next step is to understand the variable importance in projection (VIP) for the dependent variables. This is illustrated in the next section.

4.10.2.4. Variable importance in projection: H8

Table 4.62 illustrates the VIP coefficients for the independent variables used in testing hypothesis H8.

Variable Importance in the Projection

Variables	Latent Factors			
	1	2	3	4
G1	1.279	1.057	1.204	1.185
G2	1.372	1.099	1.239	1.226
G3	.455	1.057	.797	.842
G4	.524	1.004	.748	.821

Table 4.62: Variable importance in projection for H8

The VIP path coefficients conformed to the regression model used for the study by having VIP coefficients larger than 0.8 (VIP > 0.8), indicating a positive projection of resistance of change of HIT is an inhibitor to intention to use HIT. Having achieved a positive projection in the regression model, the final step is to achieve the individual path coefficients of the dependent variables. This is illustrated in the next and final section of testing hypothesis H8.

4.10.2.5. Path coefficient: H8

The final step in testing hypothesis H8 is to calculate the individual path coefficients for the dependent variables, namely the intention to use HIT factors. Table 4.63 illustrates the path coefficients for the intention to use variables.

Parameters

Independent Variables	Dependent Variables										
	C11	C10	C9	C8	C7	C6	C5	C4	C3	C2	C1
(Constant)	2.103	2.851	3.588	1.337	1.354	2.810	2.755	3.126	2.619	3.104	2.983
G1	2.345	1.461	1.848	1.403	2.278	2.172	3.002	2.364	2.632	1.997	1.629
G2	-2.061	-.912	-4.393	-1.667	-2.267	-2.288	-3.072	-2.056	-2.789	-1.768	-1.906
G3	-.797	.428	1.568	-.372	.092	.108	-.517	-.404	-.240	-.086	-.114
G4	.755	-.885	1.132	.888	.460	.127	.727	.106	.509	-.186	.274

Table 4.63: Path coefficients for H8

The individual path coefficients of the dependent variables indicated a positive result. Dependent variable C9 in Table 6.63 has the highest path coefficient of 3.588 ($\beta = 3.588$) and the lowest path coefficient being C8 which is 1.337($\beta = 1.337$). The mean of the dependent path coefficient is, therefore, calculated to be 2.60 ($\beta = 2.60$). The hypothesis H8 is, therefore, accepted due to the following empirical calculated support:

- Adjusted R_2 is greater than 0.05 ($R_2 > 0.05$)
- The latent factor weights have a correlation factor greater than 0.4 ($\omega > 0.4$) for the central factor and a correlation of greater than 0.25 ($\omega > 0.4$) for the remaining correlation factors
- The latent factor loading achieved is lower than 0.4 ($\lambda > 0.4$) indicating a negative relation of resistance to change towards intention to use
- VIP coefficients achieved are larger than 0.8 (VIP > 0.8) indicating a positive projection of resistance to change of HIT being an inhibitor of intention to use HIT
- The individual path coefficients for the dependent variables are positive in nature indicating that the independent variables (resistance to change) can be used to determine the dependent

variables (intention to use). The mean path coefficients for the dependent variables are 2.60 ($\beta = 2.60$).

The findings above confirm hypothesis H8 and illustrate that resistance to change of HIT by clinical stakeholders has a strong and significant positive effect on intention to use clinical applications. The next section summarizes the findings discussed in this chapter and concludes with verifying the research model used for the study.

4.11. Conclusion

Today, the health care sector is under "tremendous pressure to address a host of system ills; medical errors, rising costs, inconsistent quality, inefficiency, declining clinician job satisfaction, and mounting staffing shortages" (Johnston *et al.*, 2002). Improved health information technologies (HIT) are seen to be the solution to mitigating some of these issues in the health care sector. However, in implementing HIT in many health care sectors, users' acceptance has long been a barrier to the success of HIT in mitigating those concerns.

The research model used in this study attempts to bridge that gap by understanding the reasons behind the lack of user acceptance of HIT in the health care sector thereby preparing future organizations that want to implement a paperless environment. The research model used in the study was created by Bhattacherjee and Hikmet (2007), who incorporated Cenfetelli's (2004) dual factor model of IT usage and the TAM model. Figure 4.12 illustrates the tested model and the R^2 value for each relation in the model.

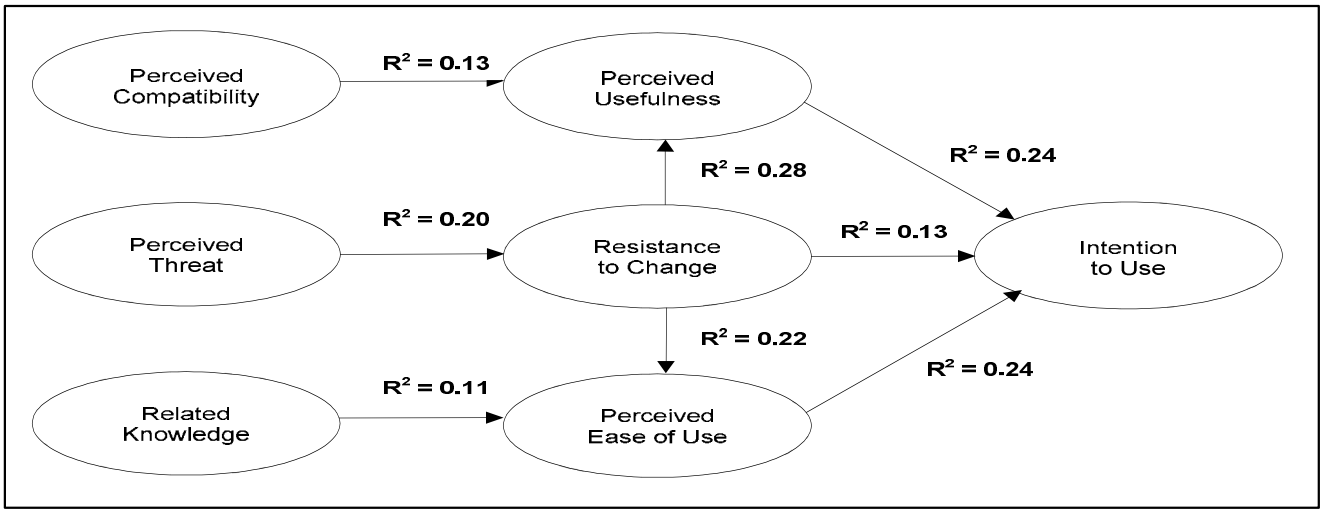

Figure 4.12: Adjusted R^2 of research model

The R^2 variances for all the relationships in the research model were tested to be positive illustrating the validity of the research model in predicting the intention to use HIT by clinical stakeholders. The research model indicates that 24% of the dependent variables perceived usefulness and perceived ease of use indicated a positive effect on the intention to use HIT while the resistance to change is 28% and 22 % in variance explaining that it is indeed an inhibitor to perceived usefulness and perceived ease of use respectively.

Chapter 4 of this study presented the analysis and the findings of the study. The instrument used in the study was also tested using confirmatory factor analysis and the research model used in the study was tested positively enabling the researcher to use the model to predict the clinical stakeholders' intention to use HIT in a paperless environment. The next chapter concludes the study by answering the questions posed in the literature review section of the study and provides recommendations based on the findings of chapter 4 and future recommendations for other organizations that intend to go the paperless route.

Chapter Five

Recommendations and Conclusions

5.1. Introduction

The preceding chapter analysed and presented the data that was collected. This chapter will address recommendations for future study and outline recommendations based on the results that were obtained in chapter four for preparing future organizations that want to go paperless and prepare them in understanding some of the resistance barriers they will encounter and thereby providing guidance in designing systems that will be accepted by the target population. In addition, the questions posed in chapter two will be answered by the researcher and final conclusions will then be discussed.

The use of information technologies, such as high speed networks, improved software; sufficient amount of data storage, coupled with the ever growing Internet has increased the amount of health care information available to anyone with access to the Internet. The problem, however, is that certain developing countries have not yet been able to realise the potential benefits that information technology brings to the health care sector due to a number of reasons, ranging from lack of infrastructure, financial limitations to cultural resistance and lack of insight as to the benefits of information technology. Another problem is that in most occasions the health care information is either not systemized or organised in a sufficient manner to that which can be used by the clinical stakeholders and more often than not the information is in paper form making it extremely difficult to make that information readily available or transportable. The clinical applications in a paperless environment are aimed at resolving some of these problems faced by the clinical stakeholders on a daily basis.

The implementation of HIT systems is seen as the mitigating factor when it comes to the current health care problems. Columbus (2002) notes that "the implementation of health informatics improves patient safety, improves clinical stakeholders office efficiency, and mitigates shortages in health human resources; however, such systems can also compromise short-term clinical stakeholders' office performance as important as the implementation process of HIT as the perceived usefulness and perceived ease of use of the system is as important in ensuring that the implementation of HIT is a success. Venkatesh and Davis (2000) state that the perceived usefulness and perceived ease of use are the two most important factors in the TAM model used to explain the reason system users accept or reject the technology.

There is no shortage in literature discussing the benefits that HIT implementations bring to organization and the people that use the systems. However, literature research discussing the resistance of HIT by the people expected to benefit from the HIT implementation is few and far between. This study used the research model developed by Bhattacherjee and Hikmet (2007) which expanded on Venkatesh and Davis (2000) TAM model. The research model addressed the resistance to HIT by clinical stakeholders and illustrated that perceived usefulness and perceived ease of use are enablers towards the intention to use HIT while resistance to change is an inhibitor to HIT. In addition to addressing the perception and preparedness of clinical stakeholders to implement a paperless environment the next section further elaborates on some of the findings and answers the research questions set out for this study.

5.2. Recommendations

The overall goal of this study was to investigate the level of preparedness and perception of stakeholders at hospitals within the eThekwini municipality to utilize a paperless environment. The findings from the study will then be able measure and provide evidence that embracing IT within the health care sector will reduce costs, improve efficiency and accuracy and ultimately leading to an improvement in the quality of care given to the patients. From a broader perspective understanding the preparedness and perception of stakeholders has broader ramifications to other organizations that want to go paperless and prepares them in understanding some of the barriers they will encounter and thereby providing guidance towards other organizations that want to pursue the journey towards becoming a paperless environment. The researcher will provide recommendations by answering the questions posed in chapter three, based on the analysis and findings of Chapter Four and the reviewed literature from Chapter Two and provide recommendations for future study.

5.2.1. How does the perceived compatibility of HIT in a paperless environment affect the perceived usefulness of HIT by clinical stakeholders?

The researcher's findings indicated that the compatibilities of the current HIT available at the hospital are aligned with the clinical stakeholders' daily activities. The frequency of the results indicates that more the 90% of the respondents felt that the current system at the hospital as compatible with the clinical stakeholders. The majority of the respondents also indicated that the current systems at the hospital provided the clinical stakeholders with the information they needed and in a format that they were accustomed to.

Ammenwerth (2003) indicates that many IT implementations fail primarily because the clinical stakeholders are dissatisfied with the system. Therefore, it is important to ensure that when implementing an HIT into a paperless environment the current system compatibilities are taken into consideration. The success of a paperless environment within a hospital not only depends on the economic benefits but also the actual use of the system by its intended audience. The HIT implementation could be within budget and timeframe allocated for the project and could also have helped reduce the administrative workforce previously required for manual work. However, if the information technology is not going to be perceived as useful by the intended users then the technology can be deemed a failure.

Many HIT systems that are built do not take into consideration the current capabilities of the clinical stakeholders and HIT systems designed by the vendor which may sometimes force the clinical staff to change their way of working to accommodate the new system (Bhattacherjee & Hikmet , 2007). This, therefore, leads the clinical stakeholders to perceive the HIT implementation as not being useful to them as it would require much more effort from their perspective to conduct daily activities. The ripple effect of clinical stakeholders not perceiving HIT as useful is that it would lead to a lack of usage of the system which could potentially lead to the project failing.

The minimum requirement would be that the clinical stakeholders should still be able to perform the same functionality as they could previously perform with less effort. The research model indicates that perceived compatibility is an enabler to perceived usefulness. Therefore, the managers and executives at the hospitals that want to implement a paperless environment should ensure that the IT vendor will be

tasked with the responsibility of doing the implementation and ensuring that a thorough analysis is done of the current compatibilities of the system.

5.2.2. How does the perceived threat of HIT in a paperless environment affect the clinical stakeholders' resistance towards using HIT?

The researcher's findings indicated that the respondents felt threatened if they had to work in a paperless environment. There could be many reasons for the clinical stakeholders to feel threatened by the concept of working in a paperless environment and it is important that the managers and executives at these hospitals uncover these threats as early as possible. The researchers' findings also indicated that approximately 20% of the respondents do not feel threatened by the HIT in a paperless environment. This could be attributed to the younger generation of respondents who are more comfortable with the technology and are more accustomed to using computers as opposed to the older generation.

Even though the study indicates that only 20% of the respondents do not feel threatened by the HIT, it is extremely important to understand the reasons clinical stakeholders felt threatened by the introduction of IT because like other sectors the health care sector is rapidly becoming more digitalized by the use of IT. Parente (2003) indicates that a number of factors can be attributed to the reasons why clinical stakeholders felt threatened by HIT, ranging from the poor introduction approach to HIT, to the lack of proper training, job loss and availability of computers to clinical stakeholders. Bhattacherjee and Hikmet (2007), note that "people resist change if they expect it to threaten the status quo, such as a potential loss of power or control over strategic organizational resources."

The research model in the study indicates that perceived threat is an enabler towards the resistance to use HIT, meaning that the more clinical stakeholders perceive HIT as a threat the less they will actually use the HIT. Therefore, it is recommended that these threats to HIT are identified as soon as possible within an organization. Once they have uncovered these threats, the next step would be to assess the relative importance of these threats and the impact they would have on the organization. “Other potential threats may include loss of organizational status, loss of power, or loss of control over organizational resources” (Markus, 1983). Managers and executives should also quantify these threats by communicating openly to the clinical stakeholders and ensure that the communication channels are always kept open and that the clinical stakeholders are allowed to voice their opinion and provide recommendations.

5.2.3. How does the related knowledge of HIT in a paperless environment affect the perceived usefulness of HIT by clinical stakeholders?

In this context, related knowledge can be recognized as the familiarity the clinical stakeholder has with the HIT. Computer literacy and familiarity of the technology is often mentioned as a prerequisite for system usage, and Laerum *et al.* (2004) note that the lack of related knowledge about a particular technology is one of the possible reasons for the low level of use amongst clinical stakeholders.

The researcher’s findings indicated that the majority of the clinical stakeholders have related knowledge regarding their current HIT capabilities thus enabling them to perceive the HIT as easy to use. However, a small percentage (15%) of the clinical stakeholders indicated that they have no related knowledge about HIT. This means that if clinical stakeholders do not have related knowledge or previous experience using HIT then they will not find the technology as useful thus resulting in a lack of usage by the clinical stakeholders.

In a study conducted by Van der Meijden *et al.* (2003) on IT barriers, they reported that clinical stakeholders in hospitals that were inexperienced at using computers favored more the paper based medical records whereas those more familiar with computers favored electronic medical records. Johnson (2001) found indications that the previous amount of self-confidence when using computers influenced the acceptance of the new technology to retrieve and edit documents. Computer skills seem to be a necessity but not a sufficient factor for IT use in hospitals, and that computers have to be readily available. Also, as Davis *et al.* (1989) argues, that usage might be more related to perceived usefulness than perceived ease of use. However, basic computer skills and related knowledge are a necessity in order for clinical stakeholders to deem HIT as useful to them in conducting their daily activities.

Another problem with HIT implementations is that the IT companies that actually do the implementation do not take into consideration the clinical stakeholders as part of their implementation plan. The clinical stakeholders are the ones that will be, firstly, using the system and, secondly, accustomed to the existing processes. In addition to that, the clinical stakeholders having not been part of the implementation would be none the wiser in using the technology and will therefore deem the HIT as not useful.

It is, therefore, recommended that clinical stakeholders be involved in the entire HIT implementation from the beginning. This would ensure that the clinical stakeholders become experts at the system and be able to relate to the technology. The research model used in this study indicates that perceived ease of use of HIT is brought about by related knowledge and it is, therefore, important that clinical stakeholders are able to relate to the technology.

The necessity to have clinical stakeholders that are IT literate will soon become as important as it is to them being able to read and write. Therefore, hospitals have to start ensuring that all clinical

stakeholders are sent regularly for training and have basic computer skills. Lastly, online learning and support measures should be put in place to ensure that the HIT is used by the clinical stakeholders in a paperless environment in the event that the clinical stakeholder requires more information regarding certain functionality within the HIT or requires more assistance regarding certain functionality of the HIT in a paperless environment.

5.2.4. What effect does the resistance of HIT by clinical stakeholders have on the perceived usefulness and perceived ease of use of HIT in a paperless environment?

There have been several advances in HIT such as electronic medical records, use of hand held devices, automated business processes, clinical decision support systems and real time access to medical information however, there will always exist some barrier that prevents acceptance of HIT. The researcher's findings indicated a strong resistance by the clinical stakeholders towards the usage of HIT in a paperless environment. More than 60% of the clinical stakeholders indicated that they would be resistant to working in a paperless environment while 20 % of the respondents have a neutral perspective on the HIT in a paperless environment. Therefore, in order for the organization to pursue the journey towards becoming a paperless organization, these barriers need to be identified, quantified and then overcome.

One of the main resistance barriers is the acceptance of HIT by clinical stakeholders. The acceptance of information technology by the relevant stakeholders in the hospitals is of the highest importance in order to increase the adoption of HIT, so that the transition towards a paperless environment is done seamlessly. Kripanont (2007), states that the satisfaction of the information technology by the clinical stakeholders is essential to the actual survival of the system. A large number of HIT implementations

that have either failed or been plagued with difficulty are those which the clinical stakeholders are dissatisfied with (Ammenwerth, 2003). The high number for this failure rate can be attributed to the lack of acceptance of the system by the intended users because the system was built without taking into consideration the manner in which the clinical stakeholders go about their daily activities.

More often than not the lack of perceived usefulness and perceived ease of use of HIT can be attributed to the lack of training or lack of understanding of the HIT. Therefore, if the clinical stakeholders resist the technology they would also perceive HIT as not useful or easy to use. HIT can only be perceived as useful if it provides some benefit to the clinical stakeholder and can only be perceived as easy to use by being able to accomplish the same task as previously done with less effort. The research model also indicates that perceived usefulness and perceived ease of use are both enablers for intention to use HIT. Therefore, if clinical stakeholders resist the technology, the consequences of that would mean that it would negatively impact the clinical stakeholders' perceived ease of use and perceived usefulness of HIT. This ultimately leads to a lack of user acceptance of HIT.

Resistance barriers have a direct impact on the clinical stakeholders' intention to use HIT. Therefore, measures need to be put in place to ensure that clinical stakeholders are not resistant towards the HIT. These measures include, but are not limited to, are:

- Ensure that the clinical stakeholders feel that they are a part of the implementation so they do not feel threatened by the technology
- Clinical stakeholders' existing work routines and practices must be taken into consideration to ensure that that the new HIT implementation adapts accordingly

- Clinical stakeholders are made aware of the potential benefit that the HIT would bring to them and the patients and how it can be used to assist the clinical stakeholders with their work and also make their work easier. If this is achieved then the clinical stakeholders would perceive the HIT as both easy to use and useful
- Availability of computers together with continuous training and support must be provided to the clinical stakeholders so that they become experts at the system
- Security and confidentiality measures of patient information must be put in place to ensure that the clinical stakeholders view the HIT as a secure system and also so that the clinical stakeholders do not use the HIT for malicious intent.

5.2.5. What are some of the resistance barriers to the lack of HIT usage within the health care sector?

Analyses conducted in chapter 4, section 4.10 indicates that the clinical applications introduced into a paperless environment should be done without drastically changing the way the clinical stakeholders currently operate. More than 60% of the clinical stakeholders indicated that they would be resistant to working in a paperless environment while 20 % of the respondents had a neutral perspective on the HIT in a paperless environment. If the clinical stakeholders perceive the introduction of clinical applications as a threat to their jobs they would resist the technology, which will minimize the use of the clinical applications by the intended users. This is further elaborated on by the research model which indicates that perceived threat is an enabler for resistance to change.

The introduction of information technology (IT) within the health care sector can result in many possible changes at different levels. The changes that come with HIT implementations can range from daily

activities that the clinical stakeholders go about to departmental changes as a whole. These changes could affect the quality of care of both services and medical care received by the patients. "One of the largest barriers to HIT implementation and adoption is resistance from clinical stakeholders, who refer to computer anxiety, increased time for orders, and decreased interaction with patients, and lack of integration with physician workflow among their primary concerns" (Parente, 2003). The most common mechanism used to overcome this barrier is to get user involvement in the HIT implementation and make the users aware of the benefits that the clinical applications bring to both the patients and the clinical stakeholders, without them feeling that they are losing control over their jobs. Columbus (2000), refers to user involvement as the "participation in the system development and implementation processes by representatives of the target user groups."

The introduction of clinical systems in hospitals are, as previously mentioned, thought to improve both the quality and efficiency of health care delivery, which in turn implies a change of the way things are performed. Changes are not necessarily easy to achieve in any sector and in the health care sector with the potential life and death situations, changes might be particularly hard to achieve.

The challenges and barriers that occur in hospitals are not only due to technical limitations but also to cultural and human aspects as well. "Even as new technologies come to market and hospitals show successful implementations, current practitioners are slow to change and studies estimate that only five to ten percent of clinical stakeholders in individual practice use EMR and only 25 percent of clinical stakeholders in hospitals with computerized medication order entry systems used them" (Ingersoll et al., 2000). In order to make sure IT implementations are a success it is important to get the healthcare stakeholders involved in the project and make them understand the benefits that IT will bring to them.

Overcoming these barriers within the health care sector will be of substantial benefit to both the health care sector and the patients themselves and, among many factors, will improve the quality of care given to the patients.

5.2.6. How do the clinical stakeholders perceive the usefulness and ease of use of working in a paperless environment?

The researcher's findings indicated that the majority of the clinical stakeholders felt that the HIT in a paperless environment would be easy to use and this could be attributed to the fact that the clinical stakeholders feel that they would be compatible to work in a paperless environment. The minimum requirement for a system that is implemented to be perceived as easy to use is to be able to achieve the same results as before but with less effort. The researcher's findings also indicated that the majority of the clinical stakeholders agree that working in a paperless environment would be useful to them in conducting their daily activities. The findings of the study also indicated that the only exception to this was the writing of patient prescriptions, which is primarily due to the fact that many of the doctors are accustomed to manually writing patient prescriptions.

Sánchez *et al.*, (2005), in their study of determining the success factors for implementing electronic medical records (EMR) in France, describe the factors that influence perception and satisfaction towards EMR as; "gender, age, computer sophistication and familiarity with the technology." "Each of these factors may have a separate degree and direction of its influence on user satisfaction while other factors relating to satisfaction pertain to the user's perception of the implementation, for instance security and confidentiality of medical information" (Sánchez *et al.*, 2005). A system that is not perceived to be

useful or easy to use will, therefore, have a negative effect on the acceptance of that system thereby limiting the actual use of the system resulting in a failure of the implementation.

The analysis conducted by the researcher in chapter 4, which is illustrated graphically by Figure 4.4, indicates that more than 35.92% of the respondents perceived the clinical applications in a paperless environment as useful in assisting them to conduct their daily activities. A possible reason for this is that many of the respondents perceived the clinical applications as compatible to their daily activities and would not change the way they currently executed their activities. The research model also indicated that "perceived compatibility" is an enabler for "perceived ease of use". With the respondents indicating that the implementation of clinical applications within a paperless environment will be worth the time and effort and improved efficiency, accuracy and quality of work indicating a positive reaction towards the actual system use by the respondents meaning that they would embrace the technology within a paperless hospital.

Similarly, the results achieved for the perceived usefulness discussed in chapter 4 section 4.6, many of the respondents agreed that the clinical applications in a paperless hospital would be easy to use. This would then encourage the clinical stakeholders to use the system more often and become more familiar with it thereby improving the overall understanding of the system. Having a better understanding and greater knowledge of the system would help the clinical stakeholders in knowing the benefits of the system. Acquiring this knowledge would then improve the clinical stakeholders' perceptions of the system and would lead them to deem the system as useful. This is supported by the research which indicates that "related knowledge" is an enabler to "perceived ease of use". The results achieved indicated that a paperless environment is perceived both easy to use and useful and thus would mean the

stakeholders will intend to use the system rather than reject it. This is in accordance with the research model used in this study that indicates that perceived usefulness and perceived ease of use and enablers for intention to use HIT.

It is, therefore, recommended that the clinical stakeholders are made aware of the potential benefits that HIT would bring to the organization and the clinical stakeholders themselves so that they can perceive the HIT as useful. It is also important to make the health care stakeholders feel involved in the project and more especially if the paperless environment would require them to change. Ensuring that they feel a part of the project would enable them to accept the change that is required of the stakeholders and make them accustomed to this change rather than resisting the change.

5.2.7. What is the level of computer literacy and training required by health care professionals in a paperless environment?

The research model used in this study indicated that related knowledge is an enabler for the clinical stakeholders' perceived ease of use of the system which in turn increases their intention to use HIT. In the same way clinical stakeholders that have little knowledge or do not understand the benefits of the information system will have a negative attitude towards the system. The resistance towards the new system can be eliminated by providing training to the intended users of the system.

The researcher's findings indicated that a vast majority (90%) of the clinical stakeholders had basic computer skills and were familiar with using Microsoft office applications. In terms of training, the findings indicated that almost half (43.14%) of the clinical stakeholders did not attend any training. Another alarming statistic is that close to 40% of clinical stakeholders had little or no exposure to e-mail

programs. There are a number of reasons that could be attributed to this lack of exposure to e-mail ranging from Internet availability to the availability of computers in hospitals. Working in a paperless hospital would require clinical stakeholders to not only have basic computer skills but specialized skills at their disposal. A typical example would be the retrieving of patient information. In hospitals today, the clinical stakeholder would manually look up the patient's medical record which would be filed somewhere. However, in a paperless environment the clinical physician or nurse will be a click away from retrieving a patient's medical history and may sometimes be required to email this medical record to a different department in the hospital. It is, therefore, important to ensure that the clinical stakeholders are equipped with the necessary computer skills and are always kept up to date with new technologies by providing them with continuous support and training.

Training can also be referred to as the process of providing the users, employees and management with the concepts and logic of the information system. Providing training to the clinical stakeholders will provide a better understanding of how their jobs relate to the different areas in the hospital. If the clinical stakeholders can relate to the health information system then this would increase the clinical stakeholders' perceived usefulness of the system. This is proven true by the research model which indicates that perceived compatibility of HIT as an enabler for its perceived usefulness.

The need for health care professionals to possess basic computer skills is growing at an alarming rate as information technology within the health care sector continues to rapidly evolve. The need for health care professionals to become computer literate will soon be as important as the need for health care professionals to be able to read and write on medical paper charts. Ammenwerth (2003) describes

computer literacy as “the ability to exchange information with computers at the level appropriate to the problem the user wishes to solve.”

Providing the relevant training to the clinical stakeholder is a necessity in ensuring that the users of the system accept the technology and use it as intended. Venkatesh and Davis (2000) also note that “organizations should consider providing general computer training programs to increase users’ computer awareness and self-efficacy and that, given valuable training programs and technical support, will efficiently enhance individual capabilities and their perceptions and also increase their perceptions of system ease of use and usefulness.” The health care sector has to embrace the information technology renaissance in order to improve efficiency and improve quality of care.

It is, therefore, recommended that as part of the implementation plan, comprehensive training should be allocated to stakeholders and users of the system. A lack of training and insight into the systems implemented within a paperless environment would lead to the intended audience lacking an in depth knowledge and understanding of the system, meaning that they would not know the benefits that the information system brings to the organization. Sánchez *et al.* (2005) indicated that one of the success factors in an implementation is the familiarity the intended users have with the system and this sort of familiarity is only achieved with hands-on training.

5.2.8. Future research

Future research should be focussed on measuring the perceived ease of use and perceived usefulness of a paperless environment between different time periods. Due to the limited time frame of this study, the researcher was unable to conduct such a survey. The research would indicate the initial perception that stakeholders have on the paperless environment and determine whether or not, with time, the perception

of usefulness or ease of use of a paperless environment by the relevant stakeholders has increased or decreased.

Future research could also be conducted on a much broader sample of health care stakeholders covering each and every discipline within the hospital to determine their perception and level of preparedness for implementing a paperless environment. This would, however, require a much longer period to collect and analyze the data.

The research model used in the study indicated that the enablers for HIT usage are perceived usefulness and perceived ease of use. There may be other factors that are enablers and inhibitors to HIT usage that can be the subject for future research. In addition to perceived threats being an enabler to resistance to change, future research should be conducted on other enablers of resistance to change.

The researcher targeted both private and public hospitals to undertake the study within the eThekwini municipality. The hospital that eventually agreed to participate in the study was a private hospital. The general consensus is that private hospitals are more established than public hospitals in terms of infrastructure and financial backing. Therefore, future research should be undertaken that does a comparison between clinical stakeholders from both private and public hospitals in order to measure the perception and preparedness of those hospitals to pursue the journey towards becoming a paperless environment. This could also be extended to different hospitals in different parts of South Africa, thus enabling the researcher to generalize the findings across the whole of South Africa.

5.3. Limitations

One of the limitations of the study is that the sample of respondents from the hospital cannot be representative of each and every discipline of health care professionals within the hospital. This study is limited to healthcare stakeholders who would interact with the clinical applications in a paperless environment on a daily basis to conduct their activities.

This study was undertaken in an environment where there exists a lack of related knowledge pertaining to the benefits of HIT and, in certain circumstances, where HIT is perceived as a threat. Such circumstances could be an inhibitor to information given by the respondents when answering the questionnaire. This could lead to a restricted sample size and a limited response rate.

The researcher was only limited to one hospital for the study and this was primarily due to many hospitals not wanting to participate in the study. Due to many constraints including budget and timeliness the researcher was not able to visit every hospital within the eThekwini municipality to verify the level of preparedness of hospitals to implement a paperless environment.

The researcher was only limited to staff at one private hospital which meant that the sample population was relatively small. A larger sample size would have increased the reliability of the findings of the study. Due to time constraints the researcher was unable to include other hospitals and stakeholders in the study, which would have enabled the researcher to generalize the findings across to other hospitals in the city, the province or the country at large.

The study has used a certain number of scenarios occurring within the health care sector and hospitals to illustrate what can be done to improve the perceptions of health care stakeholders of paperless

environments and ultimately accept the information technology. However, not all the scenarios used in the study, have been fully investigated to determine whether they have had the desired outcome or not. Other external factors such as Internet connectivity, return on investment and IT infrastructure were not in the scope as part of the objectives for this study.

5.4. Conclusions

Health information technology (HIT) is emerging more and more within the health care sector because of the benefits that accompany these technologies. Some of the expected benefits include streamlining of business processes, cost reduction, automation of processes, improved quality and increased efficiency. However, in order to explore the potential benefits that information technology brings to a paperless environment certain barriers need to be overcome. These barriers include but are not limited to, high failure rate of implementations, high costs associated with these technologies, poorly designed systems that negatively affect both patients and staff and lack of acceptance.

One of the leading inhibitors towards the adoption of HIT with many hospitals is the user acceptance. While IT in the health sector continues to rapidly evolve and transform, it is also vital to have an insight into users' acceptance and perceptions towards the technologies that they will be faced with on a daily basis. The research model used in the study specifically addresses the reasons for acceptance or lack thereof of HIT usage. The research model created by Bhattacherjee and Hikmet (2007) extends on the TAM model and indicates that the perceived usefulness and perceived ease of use of a system is an enabler for the acceptance of the HIT whilst resistance to change is an inhibitor to HIT usage.

This study indicated that a positive perception pertaining to the ease of use and perceived usefulness of clinical applications in a paperless environment enables increased acceptance of HIT while a negative perception pertaining to the ease of use and perceived usefulness of clinical applications in a paperless environment positively influenced resistance to change. The study also illustrated that an enabler for resistance to change is if the technology is perceived to be a threat, however, other contributing factors to the resistance to change where not taken into consideration. Finally, the model concluded that related knowledge and compatibility of HIT by the clinical stakeholders are positive enablers for the perceived usefulness and perceived ease of use of HIT.

The study has illustrated that a paperless hospital can be implemented with the vision of higher efficiency, improved accuracy and new ways of delivering health care with the expected acceptance of the HIT systems by the clinical stakeholders. However, in order to achieve this goal, certain acceptance barriers need to be overcome and the study also illustrated what these barriers are and how they can be overcome. As much as the health care industry needs to embrace IT in order to experience the potential benefits of IT, the minimum requirements of clinical stakeholders still needs to be taken into consideration, if an organization pursues the journey towards becoming a paperless environment.

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Appendix 1

Glossary of Terms

Accountability – for information means that medical personnel must provide identification for accessing the EHR and for entering and using information in the EHR.

Automated Dispensing Machines (ADM) – This technology distributes medication doses.

Availability – of information means that the information is accessible and useable as required to perform the necessary tasks relating to diagnosis, treatment, nursing, physical rehabilitation

Bar Coding – Bar coding in a health care environment is similar to bar-code scanning in other environments: An optical scanner is used to electronically capture information encoded on a product. Initially, it will be used for medication (for example, matching drugs to patients by using bar codes on both the medications and patients' arm bracelets), but other applications may be pursued, such as medical devices, lab, and radiology.

Clinical Decision Support System (CDSS) – CDSS provides physicians and nurses with real-time diagnostic and treatment recommendations. The term covers a variety of technologies ranging from simple alerts and prescription drug interaction warnings to full clinical pathways and protocols. CDSS may be used as part of CPOE and EHR.

Computerized Provider Order Entry (CPOE) – CPOE in its basic form is typically a medication ordering and fulfilment system. More advanced CPOE will also include lab orders, radiology studies, procedures, discharges, transfers, and referrals.

Confidentiality – means that information entered into an EMR is not disclosed to unauthorized parties. Confidentiality is the basis of trust between doctor and patient. If confidentiality cannot be ensured, the patient may choose to withhold information from the doctor with the inevitable risk of endangering the correct diagnosis and treatment. Needless to say, the multiplication and easy spread of information from computer to computer gravely endangers the confidentiality.

Electronic Health Record (EHR) – EHR were originally envisioned as an electronic file cabinet for patient data from various sources (eventually integrating text, voice, images, handwritten notes, etc.). Now they are generally viewed as part of an automated order-entry and patient-tracking system providing real-time access to patient data, as well as a continuous longitudinal record of their care.

Electronic Materials Management (EMM) – Health care organizations use EMM to track and manage inventory of medical supplies, pharmaceuticals, and other materials. This technology is similar to enterprise resource planning systems used outside of health care.

Health care Providers – This group of people that provide healthcare are namely physicians, nurses, and clinical technicians.

Information Society; is a society where the creation, distribution, diffusion and manipulation of information is a significant activity.

Integrity – of information means the information has not been altered or modified in an unauthorized manner. The security issue is to prevent unauthorized staff or others to alter information. Also, addition, deletion and changes of information made by authorized staff must be tracked and kept in record.

Interoperability – This concept refers to electronic communication among organizations so that the data in one IT system can be incorporated into another. Discussions of interoperability focus on development if standards for content and messaging, among other areas, and development of adequate security and privacy safeguards.

Picture Archiving and Communications System (PACS) – This technology captures and integrates diagnostic and radiological images from various devices (e.g., x-ray, MRI, computed tomography scan), stores them, and disseminates them to a medical record, a clinical data repository, or other points of care.

Radio Frequency Identification (RFID) – This technology tracks patients throughout the hospital, and links lab and medication tracking through a wireless communications system. It is neither mature nor widely available, but may be an alternative to bar coding.

Return On Investment (ROI) – The monetary amount of gain or loss made on an investment.

On-Line – In computer technology and telecommunication, on-line means being connected to a system (e.g. the internet) and is in operation (e.g. surfing the web).

Appendix 2

Ethical Clearance

UNIVERSITY OF
KWAZULU-NATAL
University of KwaZulu-Natal
Research Office
Govan Mbeki Centre
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21 January 2011

Mr V Ramharuk
School of Information Systems and Technology
Westville Campus

Dear Mr Ramharuk

PROVISIONAL APPROVAL

PROTOCOL: Perception and preparedness of stakeholders at hospitals to utilize a paperless environment
ETHICAL APPROVAL NUMBER: HSS/0004/2011 M: Faculty of Management Studies

In response to your application dated 21 January 2010, Student Number: **200206184** the Humanities & Social Sciences Ethics Committee has considered the abovementioned application and the protocol has been given **PROVISIONAL APPROVAL** subject to gatekeeper permissions from the Department of Health and from managers of all hospitals involved.

Final approval for this project will be given once the above conditions have been met. In case you have further queries/correspondence, please quote the above reference number.

Kindly submit your response to the Chair: Prof. S Collings alternatively you can contact Ms Sushiela Naidoo at the Research Office on 031-2608200.

Yours faithfully

Professor Steve Collings (Chair)
HUMANITIES & SOCIAL SCIENCES ETHICS COMMITTEE

SC/sn

cc: Mr. A Marimuthu (Supervisor)
cc: Mrs. C Haddon

Appendix 3

Introduction letter to questionnaire

Please note that some alterations in the spacing of the introduction letter have been implemented in order to maintain consistency.

UNIVERSITY OF KWAZULU-NATAL
SCHOOL OF MANAGEMENT STUDIES

Dear Respondent,

Research Project

Researcher: Mr. Vikash Ramharuk
Institution: University of Kwa-Zulu-Natal
Telephone: 031 260 7237
E-mail: vikash.ramharuk@accenture.com
Supervisor: Ashley Marimuthu (Tel: 0845124570)
E-mail: Marimuthum@ukzn.ac.za

I am Vikash Ramharuk, a Masters student at the University of KwaZulu-Natal in the department of Information Systems and Technology. You are invited to participate in a research project entitled: ***"Perception and preparedness of stakeholders at hospitals to utilize a paperless environment"***. The purpose of the study is to investigate the Information and Communication tools available that can be used in the health care sector that would help evolve hospitals into becoming paperless and thereby investigating the perception and preparedness of stakeholders at hospitals within the ethekwini municipality to utilize a paperless environment. This would thereby provide theoretical strategies and guidance aimed at preparing future hospitals that are looking to become paperless.

Through your participation the researcher will be able to measure the stakeholders perception and preparedness to implement a paperless environment in the etekwini municipality. The results from the study will go a long way in assisting the hospital to determine whether or not a major obstacle has been eliminated by ending the use of the paper-based medical record, and whether or not having a workforce familiar with working in a computerized environment makes further improvements easier to achieve.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. Confidentiality and anonymity of records identifying you as a participant will be maintained by the School of Management Studies at UKZN.

The survey should take you about 15 minutes to complete. I hope you will take the time to complete this survey.

If you have any questions or concerns about completing the questionnaire or about being in this study, you may contact me or my supervisor. This project has been approved by the Ethics Clearance Committee at the University of KwaZulu-Natal.

Sincerely.

……..
Vikash Ramharuk
Registration Number: 200206184
Cell Number: 0847845274
E-mail: vikash.ramharuk@accenture.com

Appendix 4

Respondent Statement

Respondent Number: _____

Respondent Statement

To be completed and signed by all respondents as permission that responses may be used.

Research Project:

Perception and preparedness of stakeholders at hospitals to utilize a paperless environment

Researcher: Mr. Vikash Ramharuk
School of Information Systems & Technology
Faculty of Management Studies
University of KwaZulu-Natal

I _____ (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire. I hereby give permission that my responses may be used in the above research project, provided that no of my personal details will be made public in the published research report.

Signature_____ Date_____

Appendix 5

Questionnaire

Please note that some alterations in spacing of questions have been implemented in order to maintain consistency.

UNIVERSITY OF KWAZULU-NATAL

DEPARTMENT OF INFORMATION SYSTEMS & TECHNOLOGY

- The researcher would kindly request your assistance in completing this questionnaire.
- The information gathered will be used as part of completion of a Masters Degree research project.
- Your responses in this questionnaire will remain private and confidential and the information supplied will be used solely for the purpose of this study.
- **Please answer all questions truthfully**

This questionnaire consists of 8 pages including the cover page, 10 sections and 68 questions. You are requested to answer all questions, by marking with a cross at the spaces provided and writing in block letters (where necessary) with a **PEN**.

A. General Information

1. Gender ☐ Male ☐ Female

2. Race ☐ African ☐ Asian ☐ Coloured ☐ Indian ☐ White

3. Age Group ☐ < 20 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 >

4. Type of employment ☐ Full Time ☐ Part Time

5. Clinical Position ☐ Doctor ☐ Nurse ☐ Other

B. Experience with Computers

1. Do you regularly work with computers in this hospital? ☐ Yes ☐ No

2. If you have answered Yes to the above question, Do you enjoy working with computers in this hospital?

☐ Yes ☐ No

3. If you have answered No to the above question, Please specify a reason?

4. What type information system do you interact with on a daily basis to do your job?

☐ Computerized ☐ Manual

5. If you have answered Computerized to the above question, what clinical applications do you work with: [Choose ALL that is applicable]

- ☐ Electronic Health Records
- ☐ Computerized Provider Order Entry
- ☐ Clinical Decision Support Systems
- ☐ Picture Archiving and Communication Systems
- ☐ Other

6. If you have answered Other to the above question, Please specify the clinical application used?

7. What do you use to access the clinical applications in this hospital?

- ☐ Hand Held Devices
- ☐ Laptops
- ☐ Workstations
- ☐ Other

8. If you have answered Other to the above question, Please specify the application used?

9. How often does this hospital's current system provide precise information that you need?

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

10. How often are the hospital's current systems accurate?

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

11. How often do you think the results presented from the hospitals current systems are of a useful and clear format?

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

12. Are the systems implemented in the hospital currently easy to use?

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

13. How often do the current systems implemented at this hospital give you the information you need in time?

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

C. Use of clinical applications in the hospital

If this hospital had to become a paperless environment how often would you use the clinical applications available to do the following tasks?

1. Review the patient's problems

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

2. Seek out specific information from patients records

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

3. Obtain results from tests

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

4. Enter daily notes

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

5. Order clinical laboratory analysis

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

6. Obtain the results from clinical laboratory analysis

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

7. Refer patients to other departments or specialists

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

8. Write prescriptions

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

9. Collect patient information

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

10. Complete ad-hoc tasks such as leave forms, claim forms etc…

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

11. Give general medical information to patients

☐ Never ☐ Seldom ☐ Often ☐ Most of the time ☐ Always

D. Satisfaction evaluation of clinical applications in a paperless environment

1. Would the implementation of clinical applications at this hospital to establish a paperless environment be worth the time and effort to use it?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

2. Do you think that implementing clinical applications in this hospital would improve your departments work efficiency?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

3. Do you think that implementing clinical applications in this hospital would improve your departments work accuracy?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

4. Would the implementation of clinical applications at this hospital to establish a paperless environment improve your department's quality of work?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

5. Do you think that implementing clinical applications in this hospital would improve your own tasks?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

6. Do you think that the systems in a paperless environment will be easy to use?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

7. Do you think you find it easy to get the system to do what you want it to do?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

8. Do you think you find it easy to become skilled at using the system?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

---

E. Related computer knowledge and skills

1. Have you previously had exposure to computerized electronic applications other than in this hospital?

☐ Yes ☐ No

2. Have you previously had exposure to software programs?

☐ Yes ☐ No

3. Have you previously had exposure to e-Mail programs?

☐ Yes ☐ No

4. Have you previously had exposure to ordering online (e.g. from a website)?

☐ Yes ☐ No

5. If you do use clinical applications in the hospital, how would you rate your computer skills in working with the clinical applications in the hospital?

☐ None ☐ Low ☐ Average ☐ High ☐ Expert

6. How would you rate your computer skills in using Microsoft applications such as Microsoft Word, Microsoft Excel, and Microsoft PowerPoint etc…?

☐ None ☐ Low ☐ Average ☐ High ☐ Expert

---

7. Have you ever received computer training in general? ☐ Yes ☐ No

---

F. Perceived Threat of computerized clinical applications in a Paperless Environment

1. Do you feel that you may loose control over the way you currently do your daily activities if you had to use computerized clinical applications in a paperless environment?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

2. Do you feel that you may loose control over the way you make clinical decisions if you had to use computerized clinical applications in a paperless environment?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

3. Do you feel that you may loose control over the way you order patients tests if you had to use computerized clinical applications in a paperless environment?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

4. Do you feel that you may loose control over the way you access clinical information such as patient data and lab results if you had to use computerized clinical applications in a paperless environment?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

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G. Resistance to change in a Paperless Environment

1. I do not want the paperless environment to change the way you order you currently order patient tests.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

2. I do not want the paperless environment to change the way you order you currently make clinical decisions?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

3. I do not want the paperless environment to change the way you order you currently interact with other people in your job?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

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4. I do not want the paperless environment to environment change the way you order you currently do your daily job?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

Appendix 6

Letter from professional editors group (PEG)

I, Nicholas K. Challis, of the professional editors group (PEG), have started and completed an edit of a Masters degree

by Mr Vikash Ramharuk on:

"The perception and preparedness of stakeholders at hospitals to utilize a paperless environment."

This took place during June 2011.

I have thoroughly checked his work.

Sincerely,

Nicholas

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