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An empirical study of the technological, organisational and environmental factors influencing South African medical enterprises' propensity to adopt electronic health technologies

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AN EMPIRICAL STUDY OF THE TECHNOLOGICAL, ORGANISATIONAL AND ENVIRONMENTAL FACTORS INFLUENCING SOUTH AFRICAN MEDICAL ENTERPRISES' PROPENSITY TO ADOPT ELECTRONIC HEALTH TECHNOLOGIES



A RESEARCH REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF COMMERCE IN THE FIELD OF INFORMATION SYSTEMS

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Submission Date: 30 May 2014

DECLARATION

I declare that this research report is my own unaided work, except to the extent indicated in the text, acknowledgements and reference matter. It is being submitted for the 50% research component of a Masters of Commerce degree (by Research and Coursework) at the University of the Witwatersrand, Johannesburg.

It has not been submitted before for any other degree or examination in this or any other institution.

_____
Motlatsi Mamatela

_____
Date

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ABSTRACT

Information and communication technologies can be used to deliver healthcare services and improve the healthcare system. Any electronic healthcare system whose usage results in the efficient and enhanced quality of healthcare is an eHealth system and can be beneficial for medical enterprises. Despite the advantages that eHealth systems offer, medical enterprises are often reluctant to abandon their paper-based systems and embrace eHealth solutions.

Through a review of existing eHealth literature, this study identified generic technologies used within South African medical enterprises. Fourteen (14) technologies, that represent a basket of eHealth systems for supporting the business management, professional clinical informatics, patient information storage and consumer health informatics functional areas, were identified. The study then aimed to determine the state of adoption of these technologies as well as the factors influencing adoption. The technological, organisational and environmental (TOE) factors that contributed to the current state of adoption were identified through a review of existing TOE literature. A model that explores the effects of these pre-determined TOE factors on the propensity to adopt eHealth was developed and tested. A cross-sectional, quantitative study was carried out and survey data was collected from a sample of 130 medical enterprises in South Africa. Data was collected using a structured questionnaire. Correlation analysis was used to test the model's hypotheses and hierarchical regression was used to test the overall TOE model. By using the TOE framework, the study has provided a theoretical contribution and addressed a gap in the literature into the barriers and determinants of the adoption of information and communication technologies (ICTs) in healthcare.

The results of the study show that South African medical enterprises use systems that range from simple electronic fund transfer systems to more complex electronic record and clinical decision support systems. Of the 14 technologies that were identified, business information systems such as medical aid claims submission systems and electronic record systems for patient and fee related information were the most adopted while a steady, but continued increase in the adoption of clinical health information systems was observed. Specifically, the study reveals that electronic fund transfer systems are the most adopted systems while ePrescription systems are the least used. Furthermore, the study shows that in addition to the enterprises' operating period, perceived benefits, IT infrastructure, senior clinician involvement, resource commitment and external pressure are correlated with the propensity to adopt while system complexity is a barrier to technology adoption.

Keywords: eHealth, Propensity to Adopt, Technology-Organisation-Environment (TOE) Framework, Diffusion curve, Healthcare business management systems, Professional clinical informatics, Patient Information storage system, Consumer Health informatics.

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1. CHAPTER 1 : INTRODUCTION

1.1 CONTEXT AND BACKGROUND

Electronic health (eHealth) is a term evolving from "health telematics" and "medical informatics" (Iakovidis, Le Dour, & Karp, 2007) and denotes the use of information and communications technologies (ICTs) in the delivery of healthcare (Jordanova & Lievens, 2011). Existing definitions, from a technological perspective, suggest that eHealth is broad and that it incorporates a number of technologies. Oh, Rizo, Enkin and Jadad (2005) concluded that eHealth encompasses all forms of ICTs which range from basic internet and e-mail services such as health websites and email discussions amongst practitioners, to systems that are essential in the daily operations of a medical enterprises such as electronic medical record systems. eHealth is also inclusive of the usage of mobile technology (Piniewski, Muskens, Estevez, Carroll, & Cnossen, 2010) and social media technologies (Hesse et al., 2010) for improved healthcare provision. Applications such as electronic health record systems, tele-monitoring systems (including devices), mobile appointment reminder systems, medical aid claims submission systems, booking systems and electronic prescription systems are likely to impact healthcare and are likely to form part of a progressive medical organisation's eHealth system.

Eysenbach (2001, para. 3) gave a broader definition of eHealth and defined it as "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" and stated further that eHealth is not just the technology, but is "a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology". This definition alludes to the idea that eHealth systems are socio-technical systems and their adoption in the healthcare sector is influenced by the resulting complex interactions of both technical and non-technical institutional and environmental factors (Ure et al., 2009).

eHealth adoption refers to the actual deployment and utilisation of technology and does not refer to its mere acquisition by the medical enterprise (Lassila & Brancheau, 1999). Organisations that adopt technologies are often required to have competencies that enable them to maximise the benefits realised when using technology. Ruxwana, Herselman and Conradie (2010) cited the emergent benefits of eHealth as improved access to basic consumer healthcare services (i.e. access to healthcare services in rural areas), optimised health service delivery, easier access and storage of health-related information, increased efficiency of healthcare providers through enhanced connectivity and exchange of knowledge that enables medical enterprises to focus on their core competencies. The usage of eHealth also bridges the gap of health disparities by availing healthcare services to areas that would otherwise be unreachable. Despite these benefits, the diffusion of eHealth remains low (Neuhauser & Kreps, 2003). Lucas (2008) also highlighted how eHealth initiatives are piloted and tested, but have failed to permeate through main stream healthcare as quickly as might be expected.

As a result of failed eHealth projects, questions about the conditions necessary for the successful adoption of technology have been raised. There are instances where ICTs have been used successfully (Sørensen, Rivett, & Fortuin, 2008) and some organisations are more likely to progressively adopt the technologies than others. This study investigates the factors that influence the adoption of eHealth by medical enterprises in South Africa.

1.2 PROBLEM STATEMENT

eHealth is a broad concept and past research has not defined a clear basket of technologies that constitute eHealth. From a European perspective, Andreassen, Bujnowska-Fedak, Chronaki, Dumitru, Pudule, Santana, Voss and Wynn (2007) investigated eHealth usage and looked at technologies such as e-mail, e-prescriptions, appointment schedulers, internet and websites, SMS reminders and electronic patient records as important technologies for healthcare delivery. From a developing country perspective, Ashar, Lewis, Blazes and Chretien (2010) and Lucas (2008) defined eHealth as including the usage of radio, mobile telephone, fixed line telephone and broadband (both mobile and fixed line) technologies. Given that, there is a need to clearly define a basic portfolio of technologies that can be used in South Africa for eHealth. Thus, the following research question is posed:

RQ1: What constitutes the basic portfolio of eHealth technologies for a South African medical enterprise?

Technological advances can streamline work processes within a medical enterprise. In their study, del Hoyo-Barbolla, Arrendondo, Ortega-Portillo, Fernandez and Villalba-Mora (2006) sought to understand the rationale for adopting ICTs to perform changes in clinical processes at individual level and depicted the stages that individuals go through when transitioning from ICT awareness to adoption likelihood and behaviour modification. This study intends to investigate the current state of technology adoption at organisation level and highlights the degree of awareness that medical enterprises have about various eHealth technology solutions (Bharati & Chaudhury, 2006) and the current extent of adoption of these technologies. The study investigates:

RQ2: What is the current state of adoption of these eHealth technologies by medical enterprises in South Africa?

Upon identifying the list of technologies that are being used by South African medical enterprises, as postulated by research question 1 and understanding the extent to which they are being used, as postulated by research question 2, the next logical step is to identify the factors that influence the adoption of these technologies. eHealth can be used to facilitate and enhance the healthcare provision process. Yet, despite the range of applications and benefits that can be realised from adopting eHealth technologies, studies have shown that their adoption by medical enterprises in developing countries remains lower than anticipated. (Lustria, Smith, & Hinnant, 2011; Wickramasinghe, Fadlalla, Geisler, & Schaffer, 2005).

While past research (Chikotie, Oni, & Owei, 2011; del Hoyo-Barbolla, et al., 2006; Tsiknakis & Kouroubali, 2009) has explored the factors that influence eHealth usage at the individual level, factors influencing organisational level adoption have received less attention. This study draws on the Technology-Organisation-Environment (TOE) framework (Tornatzky & Fleischer, 1990) as a lens through which the impacts of technological, organisational and environmental factors on the likelihood or propensity to adopt eHealth technology are identified and explored. To this end, the following research question is posed:

RQ3: What are the technological, organisational and environmental factors influencing the propensity of South African medical enterprises to adopt eHealth technologies?

1.3 AIMS AND OBJECTIVES OF THE STUDY

In their study Grover and Goslar (1993) performed a literature review to identify and compile a list of telecommunications technologies that can be adopted by information systems practitioners. Thus to answer research question 1, the aim of the study is to adopt a similar approach and conduct a literature review to identify a list of technologies that can be used by medical enterprises. This list will serve as a basic portfolio of eHealth technologies for South African medical enterprise and address the first research question.

Upon the identification of the portfolio of eHealth technologies, their current levels of adoption will be examined. More specifically, the study's second objective is to provide a cross-sectional snapshot of the technologies currently in use within the surveyed South African medical enterprises, thus addressing the second research question. Information regarding the length of time that the enterprises have been using the technology since its inception will be collated. This information will be used to track the adoption patterns using diffusion graphs and to make deductions about each technology's adoption lifecycle. Comparisons between the technologies will be made to identify technology systems that have diffused the most or the least into the healthcare ecosystem.

This study thus benchmarks the current state of eHealth technology adoption in South African medical enterprises which can be compared against other countries whose adoption statuses are recorded in health informatics literature. This will indicate whether South African medical enterprises lag behind in terms of innovation adoption as compared to their counterparts in other countries. Srinivasan, Lilien and Rangaswamy (2002) denoted that there are multiple definitions of technology adoption, including: time to adopt, the dichotomous measure of adopt/not adopt and the extent of technology adoption. As in previous studies (Sahadev & Islam, 2005; Thong, 1999), this study will use a dichotomous measure to measure the propensity to adopt variable. Obtaining "propensity to adopt" information will then give an indication of the extent of South African medical enterprises' adoption. "Propensity to adopt" information will thus indicate how South African medical enterprises measure up relative to their counterparts in other countries. It will also allow them to identify areas where they lag in adoption, so that they can take the necessary measures to get up to par with their counterparts in other countries in those adoption areas.

The third aim of this study is to better understand the factors impacting the adoption of eHealth technologies in the South African healthcare sector, using the TOE framework as a theoretical lens. Medical organisations decisions to adopt are theorized to be influenced by TOE factors and this study identifies and explores those factors and tests their impact on the propensity to adopt eHealth. A regression model will be used to determine the impact of these factors within the TOE framework that influence an enterprise's propensity to adopt. This study will inform practice of the current state of eHealth adoption in healthcare and explain why organisations delay the adoption of such value adding innovations (Nambisan & Wang, 2000). By identifying these factors interventions can be taken to improve the likelihood of future adoption.

1.4 IMPORTANCE OF THE STUDY

1.4.1 THEORETICAL IMPACT

This study seeks to provide a theoretical contribution to information systems literature. By using the TOE framework, it addresses a gap in the literature where this framework has not been extensively used to understand eHealth adoption. For instance, the study by Tsiknakis and Kouroubali (2009) used the "Fit between Individuals, Task and Technology" (FITT) framework to analyse the social, organisational and technical factors that influence IT adoption in the healthcare domain, while studies by Chikotie, Oni and Owei (2011) and del Hoyo-Barbolla, et al. (2006) used the TAM framework to study the diffusion of eHealth technologies at individual level. Boonstra and van Offenbeek (2010) used the structuration theory to study the adoption of telemedicine, an instance of eHealth while Chatterjee, Chakraborty, Sarker, Sarker and Lau (2009) studied health technology adoption using the De Lone and McLean Model. Studying the acceptance of eHealth technology at organisational level requires a holistic view of the TOE determinants of the technology's adoption. This study evaluates the adoption of eHealth and uses the TOE framework as a theoretical lens to do so. The study complements the work of Barua, Brooks and Gillon (2010) into the implementation of national level electronic health record systems.

Many of the studies in the literature are conceptual studies, prototypes, literature reviews or are case studies. Quantitative empirical studies on eHealth adoption in South Africa are limited. To address this gap, this study defines variables within a conceptual model which outline how a broad set of contextual variables influence adoption decisions.

1.4.2 PRACTICAL IMPACT

Conducting this research builds a case for eHealth adoption. The success of using eHealth technology could benefit developing nations and enable the implementation of standard national level electronic health records. Developing countries can make use of the technology to make the accessibility of healthcare a reality. The value proposition for adopting eHealth has increased in the last few years and studying the influences of the TOE factors that influence the likelihood of adoption at the organisation level becomes inherent.

Wyatt and Sullivan (2005) listed "national policy" as a factor that encourages eHealth adoption. The implementation of nationwide health insurance system (NHI) will require the implementation of supporting eHealth systems (Bahensky, Jaana, & Ward, 2008). eHealth could help move towards services that are better co-ordinated and helps government meet its healthcare provision targets (Department of Health (South Africa), 2012). The ability of the technology to be accessed from remote areas will enable healthcare to reach patients who otherwise would not have access to medical resources, provided that the organisations that treat them have the adequate resources to access them. Large scale adoption is only possible if TOE factors are in place to support these systems. There are many drivers for large scale adoption, but there are also concerns that may cause medical organisations to err caution. The results of this study will inform practice with the reasons why organisations do not adopt IT innovations such as eHealth systems, which add value from a financial and time-saving perspective. Additionally, the research will provide information on the current adoption state of eHealth systems (Nambisan & Wang, 2000) in South Africa, ahead of the aforementioned implementation of the nationwide health insurance project.

For medical enterprises, the study results can help inform their IT investment decisions and whether to implement eHealth technologies on a larger scale. Furthermore, the results of the study can be used to inform eHealth providers of the characteristics of the medical enterprises with a high propensity to adopt and to help them work more closely to improve the skills and infrastructure of those with a lower propensity to adopt. Finally, the results can enable governments wishing to promote eHealth adoption with greater insights into the barriers and enablers and their roles in creating a more conducive regulatory environment.

1.5 DELIMITATIONS AND ASSUMPTIONS

The study is reductionist in approach and assumes the effects of individual factors can be isolated and no complex interactions between factors occur (Fitzgerald & Howcroft, 1998). The study also investigates organisations' propensity to adopt a portfolio of technologies. This may not be an accurate reflection of the propensity to adopt individual technologies within that portfolio i.e. an organisation may have a low average propensity to adopt the entire portfolio of technologies, but a high propensity to adopt one of the technologies within the portfolio.

1.6 STRUCTURE OF THE REPORT

This chapter introduced key concepts discussed in the report and gave insight to why the research is being conducted and what value it will add to both practice and academia. The aim of the study of identifying the factors that act as barriers to this technology's adoption is detailed and the impact of these factors on propensity to adopt is studied and discussed in subsequent chapters. The rationale for conducting the study was given and its importance, outlined. The remaining sections of this research paper will review the literature, develop the study's research model and outline the proposed methods for testing the model. The chapters will be structured as follows:

Chapter 2: Literature Review

Chapter 2 reviews existing literature on eHealth adoption and adoption propensity. The purpose of the literature review is to evaluate what is currently in the body of knowledge regarding the concept being researched. This chapter will give detail of the eHealth aspects previously validated and substantiate the existence of the research problem derived from performing a literature gap analysis.

The literature review will serve the following purpose

1. Present the current state of eHealth adoption research in information systems.
2. Identify the basic eHealth technologies for a typical modern medical enterprise and thereby address research question 1.
3. Identify variables (factors) from the TOE framework that may have an impact on or may influence the propensity to adopt these eHealth technologies.

This chapter also develops the research model and associated hypotheses relating the selected factors to adoption.

Chapter 3: Research Methodology

Chapter 3 details the quantitative research design used to address the second research question (to survey current levels of adoption) and the third research question (to test the effects of the selected TOE factors on adoption). Justification of why the quantitative research approach was chosen is given. An explanation of how the variables are measured is given and detail on how the questionnaire was constructed is given. A description of the data sources, sampling and analysis techniques is given. Limitations of the research design are detailed in this chapter.

Chapter 4: Results and analysis

In this chapter, statistical techniques are applied and used to analyse the data collected. Data is interpreted and deductions drawn from the statistical data analysis are justified.

Chapter 5: Discussion

Chapter 5 presents and summarises the deductions drawn from the data analysis. It will be determined whether the research findings emphasise or deviate from the findings in existing literature. Explanations of differences observed will be given.

Chapter 6: Conclusion

The concluding chapter defines the outcomes of the study and it is determined whether they adequately answer the research questions as to which of the tested variables are barriers and which are enablers to adoption. Implications of the outcomes for practice and academia are given. Further research avenues related to the study are given and possible extensions to the model are suggested.

2. CHAPTER 2 : LITERATURE REVIEW

This chapter aims to evaluate what is currently in the body of knowledge regarding eHealth. The first section describes the how the literature review was approached. The next section describes the search techniques and lists the resources searched to obtain literature. The following section presents the results of the review and details how they were used to identify a portfolio of eHealth technologies and to describe the current state of eHealth adoption research. As a result of this review, the first research question is addressed by defining an eHealth portfolio. The shortcomings and contributions of existing research into eHealth technologies are then described and the research gap is identified. Thereafter, the research model and the associated hypotheses relating the selected factors to adoption are developed.

2.1 SYSTEMATIC REVIEW OF RESEARCH ON EHEALTH ADOPTION

To conduct a systematic literature review into eHealth adoption, the approach of Levy and Ellis (2006) and Brereton, Kitchenham, Budgen, Turner and Khalil (2007) was taken. There are three phases to the review, commencing with the planning phase. This phase describes a process collectively known as the search strategy, which involves building the search string using search terms and Boolean logic, identifying data sources and defining inclusion and exclusion criteria. This is then followed by the processing phase where the articles are analysed, synthesised and classified into information that can serve as a foundation upon which new research can be built. Finally, the results are aggregated and reported. A description of how the body of knowledge impacts the study is given and a research gap is identified.

2.2 SEARCH STRATEGY

The search strategy used by Turner, Kitchenham, Brereton, Charters and Budgen (2010) was adopted and provides the inputs for the literature review. The search strategy used to obtain literature pertaining to the adoption of and propensity to adopt eHealth systems included the selection and searching of 10 accessible electronic academic databases which host top ranked Information Systems and Health Informatics journals: the BioMed Central, EBSCOhost, IEEE Xplor, JSTOR, ProQuest ABI/ INFORM, SAGE Premier Online, Association for Computing Machinery, PubMed Central, ISI Web of Science and ScienceDirect. Google scholar was used as a supplementary academic search engine, as it indexes other databases and journals that may have been omitted during the selection. Search terms and strings, “eHealth adoption” or “eHealth” or equivalents thereof (i.e. “e-Health” or “electronic health system” or “healthcare information system” or “ICT for healthcare”) were used to perform database lookups to obtain articles. Non-relevant articles, trade articles determined on the basis of publication journal and opinion pieces were omitted on title and abstract review.

To summarise, the following the selection criteria were applied:

a. Articles were selected if they were relevant and included the keywords in the title, abstract and keywords list.
b. Articles that have been cited by others were preferred.
c. Articles were preferred if they were published in highly ranked Information Systems and Health Informatics journals. The journal ranking system reported by Peffer and Ya (2003) was used to select Information Systems articles while

prominent journals highly ranked or indexed highly by the ISI Web of Science (medical informatics category) were used to select Health Informatics articles.

2.3 RESULTS OF THE SYSTEMATIC LITERATURE REVIEW

The search resulted in 89 peer reviewed articles that met the above selection criteria being found. Of these articles, only 25 were quantitative empirical studies and are used to indicate the current state of eHealth adoption research and are used in the preliminary development of the conceptual model. Figure 1 illustrates the approach to the literature review.

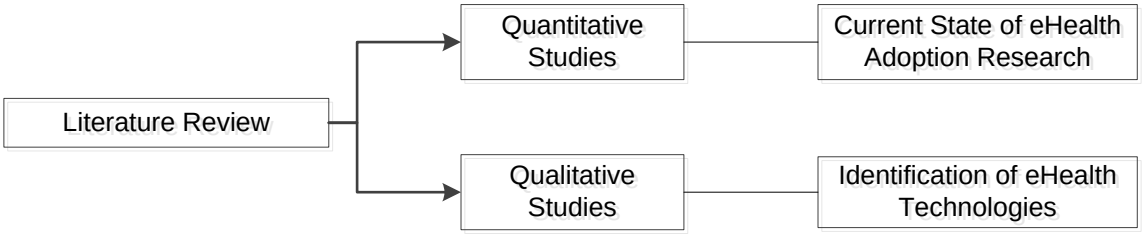


Figure 1: Approach to Literature Review

2.3.1 LITERATURE REVIEW RESULTS: IDENTIFICATION OF TECHNOLOGIES

This study's first research question is: What constitutes the basic portfolio of eHealth technologies for a South African medical enterprise? Based on a review of the literature, a number of qualitative studies were used to identify a list of technologies used by medical enterprises (these qualitative studies are presented in Appendix A). These will serve as the basis for developing the list of eHealth technologies on which this study will focus. This will then allow for the second research question, which seeks to describe the current state of technology adoption, to be addressed. Moreover, addressing the first research question is a prerequisite to addressing the third research question, as it seeks to identify factors that will influence the adoption of a pre-identified list of technologies.

Although eHealth can be defined from a technical and social perspective as alluded to in the introductory chapter, it can also be defined in terms of its areas of impact in the healthcare setting. Pagliari, Sloan, Gregor, Sullivan, Detmer, Kahan, Oortwijn and MacGillivray (2005) classified the potential areas enabled by emerging technologies in a classification framework. ICTs can be utilised in any functional area within a medical organisation to support its core function of providing improved health services. ICTs can enable the efficient provision of various services within health care spectrum resulting in a superior patient experience. eHealth technologies are discussed in the literature to address the issues experienced by medical personnel and enterprises in each of the areas of the framework. The technologies identified through the literature review will be classified within a framework defined by Pagliari et al. (2005) to demonstrate how each technology is used in different healthcare settings and the purpose it serves. These areas are illustrated in Figure 2.

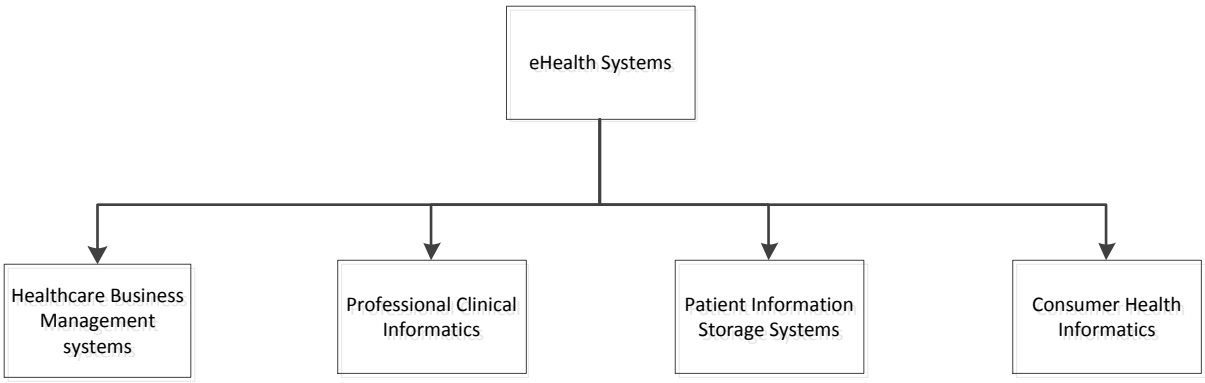


Figure 2: Framework for classifying the potential areas in healthcare that are enabled by generic technologies (adapted from Pagliari, et al., 2005)

The potential healthcare areas were identified as healthcare business management systems, professional clinical information systems, patient information storage systems and consumer health information systems. This illustrates that various ICTs can be utilised in any functional area within a medical enterprise to support its core function of providing improved health services. Each functional area's usage of technology is discussed in the sections that follow:

2.3.1.1 THE USE OF EHEALTH SYSTEMS AS BUSINESS MANAGEMENT SYSTEMS

Various health information technologies can be used in different healthcare settings. Lenz and Kuhn's (2004) study highlighted the importance of aligning information systems to healthcare processes. Their study demonstrated how Enterprise Resource Planning systems (ERP) provide integrated workflows and denoted further that healthcare information systems are used to facilitate and standardise work practices (i.e. clinical processes) and business processes (i.e. administrative purposes). Anderson (1997) concurred and noted that computer based information systems in healthcare are primarily implemented for administrative workflow purposes. More advanced e-referral, e-booking and e-prescriptions systems can be integrated into a medical organisation's healthcare system. As such, eHealth can be used to facilitate the healthcare operations management processes.

In addition to managing operational processes, medical enterprises are corporate entities and they require systems to help them manage their business and financial processes. Healthcare billing systems and tracking systems are examples of how ICT can be used to streamline administrative processes by tracking financial information and minimising administrative costs. The study by Altinkemer, De and Ozdemir (2006) illustrated how e-payment systems can be used to manage financial transactions, medical aid claims and payments incurred during each step of the healthcare provision process while other studies (Scott, 2007; Tawfik, Anya, & Nagar, 2012; Tu, Zhou, & Piramuthu, 2009) showed how this objective can be achieved using custom healthcare information systems. Business value to the healthcare networks is added through the usage of technology for business management. Therefore a comprehensive eHealth portfolio may include technology systems for prescribing and dispensing medication, for booking appointments and for submitting medical aid claims.

2.3.1.2 THE USE OF EHEALTH SYSTEMS AS PROFESSIONAL CLINICAL INFORMATION SYSTEMS

eHealth systems are not only beneficial to administrative and business personnel, but can be used by physicians within the medical organisations as clinical information systems. Professional Clinical Information systems, instantiated by decision support systems, are another component of the framework defined by Pagliari et al. (2005), that when the technology is used for this purpose, the effectiveness and quality of the healthcare services provided is improved. Other key healthcare aspects within a medical enterprise, that clinical information systems can help facilitate, are its diagnostic capabilities and its ability to administer adequate patient treatment with as limited patient referrals as possible (Pancoast, Patrick, & Mitchell, 2003).

The idea is to provide physicians with as much information as required to make as accurate a diagnosis as possible. Physicians at medical organisations can use IT to facilitate job performance by acquiring and using information resources, thus reducing the risk of clinical errors. Decision support systems such as online databases and health websites can be used by practitioners as information sources and to aid in the process of decision making. Such information and other diagnostic programs help to make the correct diagnosis, thus revealing the diagnostic capabilities of ICTs (Ulieru & Geras, 2002). eHealth has the ability to improve the quality of healthcare services through more accurate and quicker diagnoses. Therefore, a comprehensive eHealth portfolio may include decision support systems.

2.3.1.3 THE USE OF EHEALTH SYSTEMS AS PATIENT INFORMATION STORAGE SYSTEMS

Doctor-patient consultations often result in the collation of patient information which is consolidated into a patient record. Due to the long retention periods and data accumulation, the volume of these records can be substantial. eHealth systems can be instrumental in managing patient clinical data. More specifically, Electronic Health Records are "longitudinal electronic records of patient health information generated by one or more encounters in any care delivery setting" (Sidorov 2006, p. 1079). Electronic records can be especially useful for the provision of storage space for clinical records, lab results and medical imagery. Electronic health records systems serve as the patient's health data repository and allow patient data to be stored long enough to identify trends and patterns in a patient's medical history (Cresswell, 2012), and as input information into clinical decision support systems. Electronic Health Record systems enable this data to be readily available to physicians who treat a patient and enables ease of access to the patient's medical history, which in turn allows them to make informed decisions during consultations. Therefore, a comprehensive eHealth portfolio may include technology systems for organising and storing patient health information in the form of Electronic Records.

2.3.1.4 THE USE OF EHEALTH SYSTEMS AS CONSUMER HEALTH INFORMATION SYSTEMS

eHealth can also be instantiated as a communication tool and systems can support clinical functions during, pre- and post- consultation. Consumer Health Information systems are part of the eHealth medical eco-system and include mobile technology based appointment reminders and email and web based messaging to facilitate doctor-patient communication (Pagliari, et al., 2005) . Such eHealth systems are beneficial to patients who require regular monitoring and eHealth can facilitate the monitoring processes without incurring costs for the

organisation and the patient (Wilson, 2003). Therefore, a comprehensive eHealth portfolio may include systems for tele-monitoring and appointment tracking.

2.3.2 PORTFOLIO OF TECHNOLOGIES

As illustrated in Sections 2.3.1.1 to 2.3.1.4, different ICT systems can be used to enhance work done in different functional areas within the healthcare system. The systems are built on various generic ICTs such as the internet, wireless and mobile platforms. The selection of the suitable platform on which an eHealth system will be implemented depends on its availability and maturity in the country. For example, African countries are more likely to opt for mobile based systems due to the highly available mobile network infrastructures while other countries may opt for internet based systems due to the lack of bandwidth constraints. As done in the study by Trivedi, Daly, Kern, Grannemann, Sunderajan and Claassen (2009), essential requirements for the successful implementation of a healthcare information system should be identified. The technology specifications should be considered such that the end-product is suitable for the medical enterprise.

Information systems literature also illustrates that the technologies that are used by medical enterprises range from basic ICTs such as email applications to more complex database based decision support systems. The literature (refer to Appendix A) illustrates that each technology can be used for different purposes in the healthcare environment. Some technologies are generic and can be used in multiple healthcare areas, while some are more specialised, only suited for certain healthcare functions. For example, the studies have demonstrated how the internet can be used as 1) a business information system when online booking applications are used (Gorm, 2002); 2) a professional clinical information system when online databases are accessed for diagnostic purposes (Bouchier & Bath, 2003); 3) a patient information system when cloud computing technologies are used for information storage (Lustria, et al., 2011) and 4) a consumer health information system when web hosted collaborative applications are used for patient doctor communication or specialist consultations (Altinkemer, et al., 2006; Ball & Lillis, 2001), respectively. In contrast, the study by Lenz and Kuhn (2004) illustrates how technologies such as ERP systems are mostly beneficial in the business information systems healthcare area.

The technologies to be included in this study were selected from this subset of technologies explored in the literature only if they complied with the selection criterion of being explored in at least 5 peer reviewed articles published between 1994 and 2012. Technologies used in primary, secondary and tertiary healthcare were considered. The shortlist is as follows:

Technology	Purpose (health context)
1. mHealth (mobile applications)	Appointment reminders
2. Tele-monitoring devices	Health data capturing, tracking and monitoring
3. Electronic Health Records	Health data storage and organisation
4. Wireless technology (Wi-Fi, Bluetooth)	Used with mobile devices (PDAs, tablets, smartphones, etc.) for patient data capturing
5. Internet and websites	Information sharing and dissemination, research
6. Email	Patient-doctor collaboration
7. Social Media	Patient-doctor collaboration, patient-patient support groups
8. e-Prescription systems	Medication dispensation
9. Online consultations	Patient-doctor collaboration
10. Image archiving	Health data storage
11. Online medical databases and decision support systems	Medical research

Table 1: eHealth portfolio (Literature Review)

Furthermore, the list was consolidated with the list obtained by surveying the websites of prominent health information systems vendors in South Africa and lists of technologies from similar, previous studies (Davis, Doty, Shea, & Stremikis, 2009; Manochehri, Al-Esmail, & Ashrafi, 2012). Product lists for the iSoft Health Group, Intersystems, Mediswitch, Tri-Four Health, and 3M software vendors were inspected. Table 2 illustrates the healthcare technology service offerings provided by these vendors.

Vendor	Website URL (Accessed 13 September 2012)	Product Name / Product Suite	Technology Type
iSoft	http://www.isofthealth.com/	Collaboration suite	Secure Internet Portals
		Lorenzo Patient Management Clinical Management	Electronic Health Records
		Laboratory	Lab test results management system
		Radiology	Digital imaging
		Pharmacy	ePrescription
		Enterprise Management General Practice Emergency	Hospital administration (bed monitoring)
		Theatre suite	Booking and administration
		Enterprise Scheduling	
		Clinical Management Suite	Decision Support
Intersystems	http://www.intersystems.com/products/index.html	Health Share	Custom Electronic health records Online communities Decision Support
		TrakCare	Electronic Patient Records
Mediswitch	http://www.mediswitch.co.za/switching	SwitchOn SwitchComm MediSwitch	Medical aid claims processing (administrative purposes)
Tri-four	http://www.trifour-health.com/pages/solutions.php	Trimed	Electronic Medical Record Billing Pharmacy Dispensing Practice Management incorporating registrations, bookings and accounts
		TriLab - Laboratory Information System	Lab results inquiries
		TriRad - Radiology Information System	Digital Image storing
		Clinical Applications	Electronic Patient Record Telemedicine
		TriFin Financial Module	Practice Administration (Invoicing, inventory management)
		Electronic Claims submission	Medical Aid claims submission
		Modern Technology	mHealth

Table 2: eHealth Portfolio (eHealth vendor website survey)

The consolidated list, which encompasses the portfolio of technologies, is as follows:

Electronic Records
1. Electronic records for patients' demographic related information
2. Electronic records for patient assessment /clinical notes
3. Electronic records for patient financial and fee related information

Electronic Ordering of tests
4. Electronic ordering of laboratory tests
5. Electronic ordering of imaging tests (i.e. X-rays, CT scans, MRI scans, etc.)

Access to test results
6. Electronic access to laboratory tests results
7. Electronic access to imaging test results (i.e. X-rays, CT scans, MRI scans, etc.)

ePayment systems
8. Electronic medical aid claims submission systems
9. EFT (Electronic Fund Transfer) systems

10. Practice administration information systems (booking / patient scheduling systems)
11. ePrescription systems
12. Business productivity software (i.e. Microsoft Word or Excel)
13. Clinical Decision Support systems to support diagnostic decisions or patient care plans
14. Online medical reference / knowledge repository (for drugs, clinical guidelines) (i.e. Medline)

These applications will constitute the portfolio of eHealth applications considered by this study. The application list is deemed suitable as these technologies are available for purchase and use in South Africa, a developing country. These technologies are classified into the aforementioned healthcare classification framework based on Hikmet, Bhattacherjee, Menachemi, Kayhan and Brooks' (2008) classification of health information systems. Figure 3 illustrates the selected technologies within the aforementioned healthcare classification framework. Applications were classified into the healthcare business management, professional clinical informatics and patient information storage systems functional areas. None of the technologies could be classified under the consumer health informatics functional area and thus applications in this functional area were not studied.

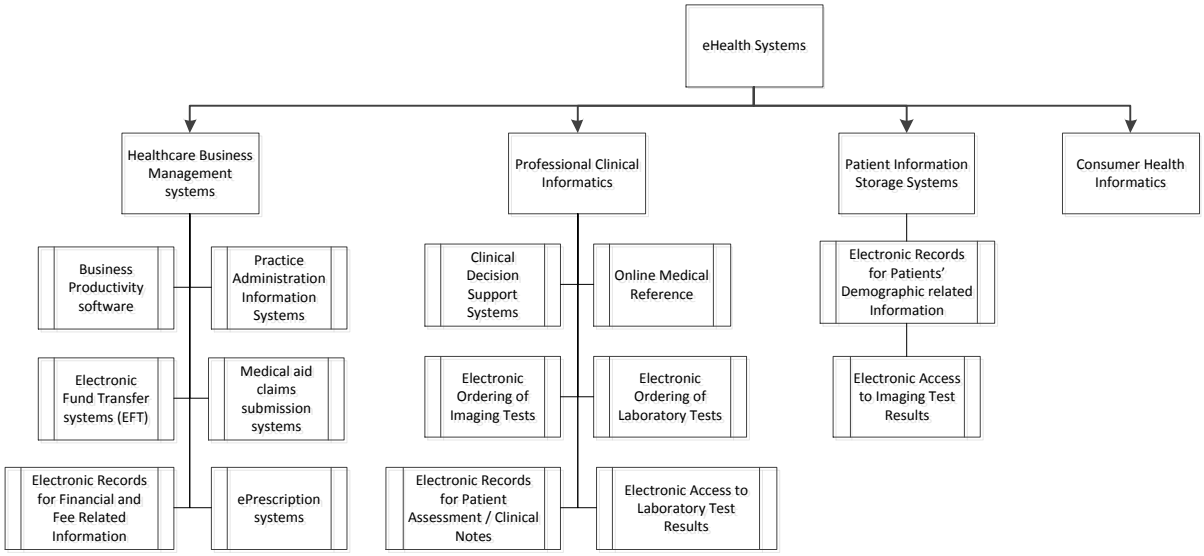


Figure 3: eHealth technologies within the classification framework (adapted from Hikmet et al., 2008)

2.3.3 LITERATURE REVIEW RESULTS : EHEALTH ADOPTION

eHealth is an emerging concept and eHealth adoption research has mostly been studied in the developed country context. Although most research articles reflect the eHealth adoption patterns and behaviour of North American countries (Ayal & Seidman, 2009; Burkhard, Schooley, Dawson, & Horan, 2010; Paré, Sicotte, Nzaou, & Balouzakis, 2011; Raghupathi & Wu, 2011; Simon et al., 2007; Vance Wilson & Lankton, 2004), European and Asian contexts are also represented. Although Tawfik, Anya and Nagar (2012) conducted a comparative multi-national study involving both developing and developed countries (UK, UAE, Nigeria), research into eHealth adoption in the developing country context remains limited (Chikotie, et al., 2011). This confirms that there are opportunities for research into eHealth in the developing country context.

Previous research shows that eHealth adoption is often conducted at individual level (Dünnebeil, Sunyaev, Blohm, Leimeister, & Krcmar, 2012; Tung, Chang, & Chou, 2008). Of the 25 empirical studies found when searching for articles specific to eHealth adoption, 16 researched eHealth adoption at individual level. Only Ayal and Seidman (2009), Burkhard, Schooley, Dawson, and Horan (2010), Chatterjee, Chakraborty, Sarker, Sarker and Lau (2009), Paré, Sicotte, Nzaou and Balouzakis (2011), Raghupathi and Wu (2011), Simon et. al (2007), Simon, et. al (2009), Tsiknakis and Kouroubali (2009) and Viitanen, et. al (2011) investigated macro-level eHealth adoption, where the concepts being investigated are associated with characteristics of a country and its health care system. These studies were atheoretical or used demographic data as variables in their models (Ortega Egea, González, & Menéndez, 2010). Conversely, the studies by Chatterjee et al. (2009) and Viitanen, et. al (2011), used the DeLone and McLean model as a theoretical underpinning; and Tsiknakis and Kouroubali (2009) and Paré et al. (2011) used the FITT and Readiness Models respectively. These results indicate a research gap, that more research based on theory (or underpinned by theoretical models) is required for eHealth adoption related studies.

A salient feature of eHealth adoption research is the variation of the theoretical models from which research models are drawn. Some studies took an inter-disciplinary approach to understanding eHealth adoption. Chang and Chang (2008) drew from the marketing

discipline and used the Service Encounters Model to study eHealth adoption while Ayal and Seidman drew from the economics discipline to quantify the benefits of eHealth. Other studies used change management theories (Paré, et al., 2011) or applied healthcare specific models as theoretical underpinnings (Kelley, Chiasson, Downey, & Pacaud, 2011).

Other studies used traditional information systems acceptance models to understand eHealth adoption. For individual adoption studies, TAM, TAM2 and UTAUT have been used to study eHealth from a user perspective to help understand both patients' and practitioners' attitudes toward technology (Crutzen, Cyr, & de Vries, 2011; Dünnebeil, et al., 2012). Some studies focused mainly on the technical aspects of the adoption of eHealth. The studies drew on the Diffusion of Innovations theory (Tung, et al., 2008) and DeLone and McLean model (Viitanen, et al., 2011) to study the technological factors that influence eHealth adoption. On the other hand, some studies only focused on organisational factors (Simon, et al., 2007). Tsiknakis and Kouroubali (2009) took a holistic approach to studying eHealth and studied adoption from a socio-organisational-technical view.

Many of the studies reported generalisability issues. This was mainly due to the methodological limitations of research as surveys, secondary data analyses and field experiments were the research methods opted for. Some of the studies had studied one eHealth technology, and acknowledged the inability of their results to be generalised to the adoption of other technologies. Moreover the cross-sectional nature of eHealth adoption research warranted longitudinal studies to be conducted. Refer to Appendices B and C for a complete summary of the shortcomings of eHealth adoption research, which was compiled from the literature.

Most recently, del Hoyo-Barbolla et al. (2006, p.1209) summarised the state of eHealth adoption research by stating that "there is no model that includes a sufficiently broad set of influencing factors to understand the multidimensionality of the reasons why people use ICT to embrace a healthcare change". A gap in the literature identified in the introductory chapter (that the TOE framework has not been extensively used to understand eHealth adoption) was verified through this literature review, thereby concurring with the notion that there are limited quantitative research studies specific to eHealth adoption at both individual and organisational levels. eHealth adoption is under-researched especially in terms of developing a theoretical understanding.

2.4 DEVELOPMENT OF THE RESEARCH MODEL

It is apparent, as illustrated by the range of eHealth technologies within the identified portfolio (Refer to Section 2.3.2), that technology can be useful in different healthcare settings. A medical enterprise's capabilities can be enhanced by using information technology. The use of technologies can result in improved billing, shorter turnaround times, staff satisfaction, customer satisfaction, general reputation, diagnostic quality and improved staff morale (Ayal & Seidman, 2009). Other capabilities enabled by eHealth include the reduction of medication errors, medical records storage costs and transcription costs (Anderson, 2007). Raghupathi and Wu (2011, p.100) stated that "put into action, the use of ICTs can enhance the delivery mechanisms, thereby leading to better quality of life, economic growth, alleviation of poverty, and improved mortality leading to overall progress in developing countries". Not all organisations, however, get to adopt eHealth due to certain enabling factors and characteristics not existing within medical enterprises.

The systematic literature review illustrated that past research into adoption is mostly at individual level and is atheoretical. A research gap, that the TOE framework has not been used to understand eHealth adoption in the South African context, is thus identified. To address this gap, and thereby answer the second and third research questions, this section develops a research model that explores the factors that impede or promote eHealth adoption at organisational level.

This study contributes to information systems literature as it uses the TOE framework to underpin a model that explains the factors that influence South African medical enterprise's propensity to adopt eHealth technologies. Wickramasinghe, Fadlalla, Geisler and Schaffer (2005) created a framework for assessing a countries' readiness and likelihood to adopt eHealth. They alluded that certain TOE factors need to be in place for successful eHealth initiatives to ensue. These factors are a subset of influencing factors and apply to medical organisations and are discussed extensively in the IS literature. The quantitative empirical studies obtained during this literature review serve as a theoretical foundation for this study (Webster & Watson, 2002), and provide a snapshot of existing eHealth adoption research. The authenticity of the variables found was supported by an independent search of the generic literature (i.e. non eHealth related articles) to find how each of the selected variables was measured in previous studies.

2.4.1 THEORETICAL UNDERPINNINGS AND RESEARCH MODEL

The third research question is: "What are the technological, organisational and environmental factors influencing the propensity of South African medical enterprises to adopt eHealth technologies?" The Technology-Organisation-Environment (TOE) Framework is drawn up to develop a conceptual model of the factors that influence the adoption of eHealth by medical enterprises. The framework has been used in previous studies to study the organisational level adoption of IT artefacts such as eBusiness, Customer Relationship Management (CRM) and knowledge management systems (Wang, Lee, & Lim, 2007; Zhu, Kraemer, & Xu, 2003; Zhu & Kraemer, 2005) .

The TOE Framework was developed by Tornatzky and Fleischer (1990). The framework is used to study the intention of organisations to adopt innovations. Nambisan and Wang (2000) later differentiated between the "intention to adopt" and "propensity to adopt" variables. In this study's healthcare context, the former variable focuses on the extent to which medical enterprises are willing to accept, implement and use a set of eHealth systems while the latter, propensity, is measured in terms of volume and is given as a score of the total number of systems used within the enterprise. The "propensity to adopt" variable is also considered to be influenced by TOE factors and the level of influence of these factors can therefore be analysed within the TOE framework (Chau & Tam, 1997).

Using the TOE framework to develop an adoption model for eHealth can provide an understanding of healthcare organisations' new innovation adoption behaviours. The TOE framework is an appropriate theoretical lens for understanding eHealth adoption because it studies organisation adoption behaviour by taking technological developments and its personnel's responses to it into account, while incorporating the organisational factors that drive the behaviour and while accounting for environmental factors that influence adoption behaviour. To this end, this research study integrates a number of TOE factors in a generalised model, to provide an understanding of the factors that influence an enterprise's propensity to adopt technology.

Many variables that are determinants of organisational adoption of an innovation have been identified in the literature. An additional search through the broader IT adoption literature (irrespective of the type of technology) was performed to identify the key TOE variables to be included in this study's research model. The following keywords "IT Adoption" and "TOE Framework" and "empirical" and "quantitative" and "survey" were used to identify studies that investigated organisational IT adoption, using the TOE framework as a basis for the research model. The same search strategy used in Section 2.1 was used, whereby 10 electronic academic databases (BioMed Central, EBSCOhost, IEEE Xplor, JSTOR, ProQuest ABI/ INFORM, SAGE Premier Online, Association for Computing Machinery, PubMed Central, ISI Web of Science and ScienceDirect) and Google scholar were searched.

Appendices D, E and F summarise the articles found, the technologies they studied and the variables that were explored. Following Tan, Tyler and Manica (2007, p. 333) the purpose of the literature search was to identify "relevant contextual and organizational factors that might affect eHealth adoption in a developing country". TOE factors that best explain the IT adoption phenomenon were selected and included in the research model.

In their study Bridges, Bierema and Valentine (2007) define propensity to adopt as the inclination an individual or organisation has, to value technology systems when making clinical and enterprise decisions. In the South African eHealth context, propensity to adopt refers to the extent to which medical enterprises' have adopted technology. The level of generic ICT adoption is examined, irrespective of whether the technology is used for clinical or non-clinical purposes. Propensity to adopt is the degree to which an organisation is receptive to implementing and using new technology systems. Propensity to adopt is also based on the idea that innovation processes are considered a success when they are accepted and integrated into the organisation and the target adopters continue to use of the product over a period of time (Bhattacherjee, 1998). Thus, propensity to adopt refers to the innovativeness of a medical enterprise which is instantiated as the total number of technology systems in use.

The research model to be addressed in this study is depicted in Figure 4. It depicts the effects of three selected technological factors (perceived benefits, technology competence and complexity) three organisational factors (enterprise size, senior clinician involvement and resource commitment and two environmental factors (external pressure and regulatory environment) on the medical enterprise's propensity to adopt eHealth. Each of these factors and their impacts are explored in the sections that follow and the hypotheses underpinning the model are derived.

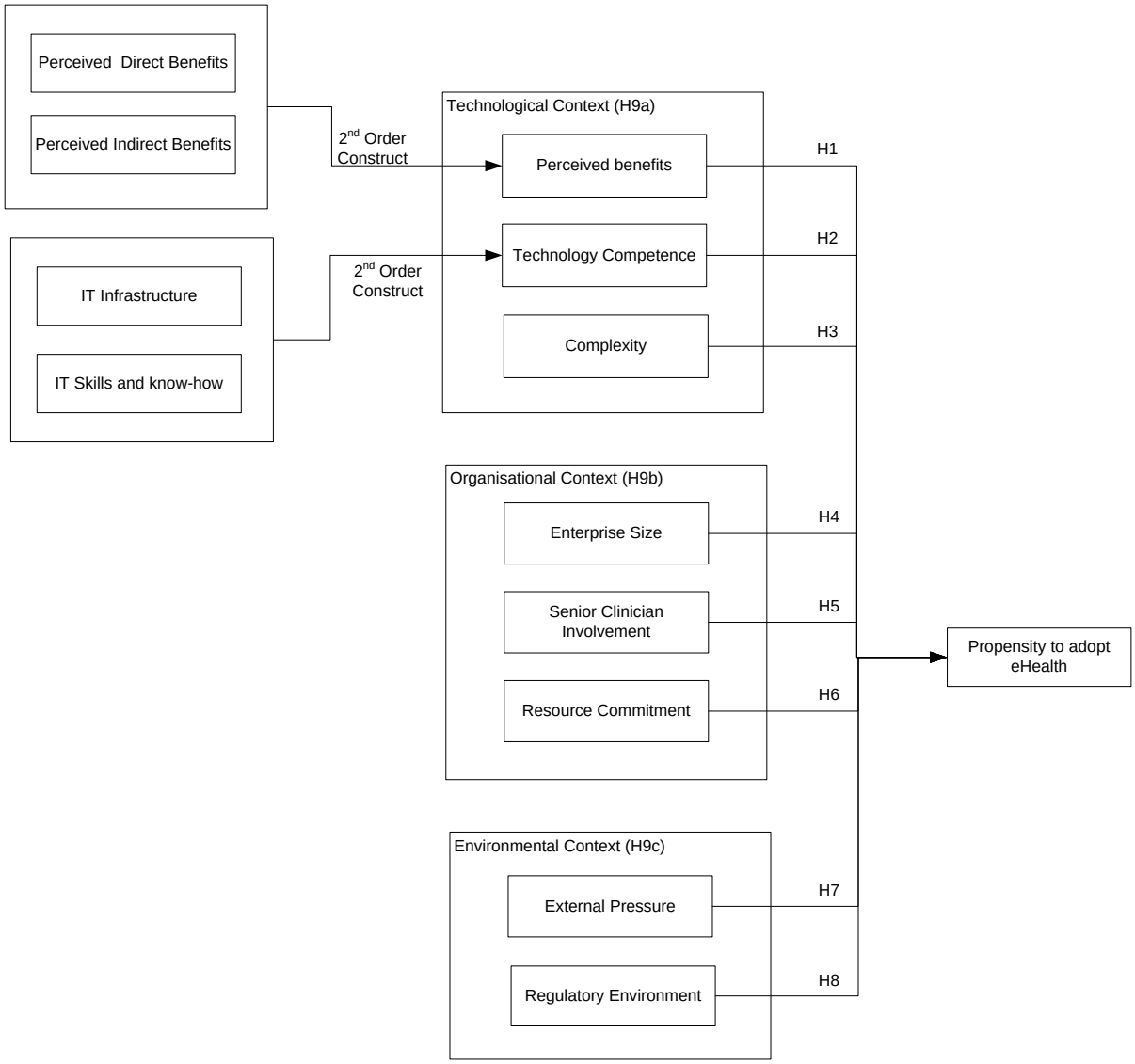


Figure 4: Conceptual model of the factors influencing a medical enterprise's propensity to adopt eHealth

2.4.2 TECHNOLOGICAL CONTEXT

An organisation's technological context comprises the technology that has been implemented and the technology available on the market. The decision to adopt technology is influenced by the available technology's fit for the organisation (its compatibility), how easily it can be integrated into the existing technology landscape (Tornatzky & Fleischer, 1990) and the extent to which the technology is used within the organisation. System characteristics are salient features of a system and can help individuals develop favourable or unfavourable perceptions regarding the usefulness of a system (Venkatesh & Bala, 2008). Prior to implementing or procuring eHealth systems, medical enterprises are informed of the technological infrastructure required and the system's security risks to ensure that no disruptions occur due to inadequate technology resources. In their assessment for eHealth preparedness, organisations will take these pertinent technology features into account as well

as the ability its personnel's ability to use the systems effectively (Wickramasinghe, et al., 2005). "As healthcare organizations continue to invest in information technologies to improve quality and continuity of care and reduce costs, understanding the technological factors that influence organizational readiness for change represents an important avenue for research" (Paré, et al. 2011, p.1).

Perceived benefits refer to the level of recognition of the relative advantage that a technology can provide to the organization (Lee & Shim, 2007). The adoption of eHealth results in direct benefits such as reduced administrative burden, increased efficiency, improved communication and fast access to information (Scupola, 2009). Medical enterprises can also increase their company visibility through their adoption of eHealth systems. For example, the launch of Health IDs by Discovery[1] pitted them as a key player in the health insurance market. Improved company visibility in turn results in increased number of patients who require efficient healthcare services. The increased efficiency resulting from the usage of the eHealth systems enables medical enterprises to meet this requirement, resulting in an indirect benefit of patient satisfaction (Discovery Health, 2012). Medical enterprises, who perceive eHealth to be directly and indirectly beneficial, as opposed to disruptive, are more likely to adopt the systems (Gu, Cao, & Duan, 2012).

H1: The greater the perceived benefits of eHealth systems, the greater will be the propensity to adopt eHealth systems

Zhu, Kraemer and Xu (2003) defined a second order construct "technology competence", whose dimensions include IT infrastructure, IT skills and know-how, as determinants of whether an organisation adopts a new ICT system. IT infrastructure refers to the existing technology resources within the medical enterprise that enable and enhance healthcare related processes, IT skills refers to the usage proficiency and the technological knowledge of an organisation which extends to non-IT professionals (Kuan & Chau, 2001), while know how refers to executives' knowledge of managing electronic health systems (Zhu, Kraemer, & Xu, 2002; Zhu, et al., 2003)

Computer proficiency, an IT skill, allows personnel within a medical enterprise to effectively use eHealth systems. A medical enterprise's personnel's skill determines the extent to which they engage with existing and future information systems. Additionally, individuals responsible for acquiring information systems need to have technology know-how, which Zhu, Kraemer and Xu (2002) define as the practical knowledge and business and managerial skills required to use eHealth systems effectively within an enterprise. Adequate infrastructure is also required to ensure that minimal disruption occur when the health information systems are being used.

IT competence can then be described as the medical enterprise's ability to use the emergent properties of their personnel's skills, senior clinician know-how and technology infrastructure (new or existing) to deliver improved healthcare services. Medical enterprises that have the IT infrastructure, the IT skills and the know-how required to engage with ICT systems are more likely to adopt additional health IT systems. This leads to the following hypothesis:

[1] Discovery refers to Discovery Holdings Limited which is South Africa's largest medical aid / healthcare plan / medical scheme service provider.

H2: The greater the medical enterprises' level of technology competence, the greater will be the propensity to adopt eHealth systems

Enterprises turn to technology to simplify clinical processes and they seek to adopt technology systems to help achieve this goal. Systems that are complex and not easily grasped by novice healthcare workers and administrators may add work burden and make it more difficult to perform daily routine tasks. Complexity is defined as the degree to which an innovation is perceived to be difficult to understand and use (Vedel et al., 2012) while Premkumar and Roberts (1999, p. 471) defined it "as the degree of difficulty associated with understanding and learning to use an innovation", a definition equating to the "perceived ease of use" variable in the technology acceptance model. Cooper and Zmud (1990) further denoted that if an enterprise employees have a perception that using a technology requires more effort and skill to complete basic tasks, as opposed to when the technology is not used being used, their organisation will be less likely to adopt innovations. It is thus hypothesized:

H3: The higher the perceived complexity of eHealth systems, the lesser will be the propensity to adopt eHealth systems.

2.4.3 ORGANISATIONAL CONTEXT

The organisational context comprises descriptive factors that characterise and classify the organisation and includes factors such as firm size, global scope and managerial obstacles (Zhu, Kraemer, & Xu, 2006). Organisation factors have an effect on the decision to adopt an innovation. This is primarily because certain organisation characteristics allow for, or hinder innovation adoption due to the organisation's level of flexibility and ability to absorb risk (Pan & Jang, 2008).

Ein-Dor and Segev (1978) list organisational size and structure as variables that affect the implementation success or failure of information systems. Larger enterprises require robust information systems that facilitate information sharing within sites. A distributed healthcare ecosystem resulting from referrals has more data sharing requirements amongst the practitioners within the enterprise and specialists (Hasselbring, 2000). Large volumes of transactions and information storage requirements result from a large number of users using a system and eHealth systems help in the management of this data and allows for easy sharing across departments. Hence, a large number of technology users impacts on the need for technology innovations.

Additionally, the study by Hung et al. (2010) denoted that although a common measure of organisation size is the number of employees within the enterprise, the number of hospital beds can also be indicative of size. This study targets enterprises who predominantly service out-patients and as such, the number of patients can be used to conceptualise organisation size. For example, the emergent properties of a large patient base, is the electronic-based, storage requirement of patient information; and the need for applications to assist in managing physician-patient collaborations. Thus, a medical enterprise's size is a principal predictor of their eHealth innovation adoption. It is thus hypothesized:

H4: The larger the size of a medical enterprise, the greater will be the propensity to adopt eHealth systems.

Grandon and Pearson (2004) denoted that management's perceptions of the strategic value of eHealth systems, influence their advocacy for the adoption of the systems within a medical enterprise. Senior clinicians play a critical role in ensuring the successful deployment of eHealth systems (Zhu, Li, Wang, & Chen, 2010). Additionally, from a change management perspective, technology changes are often met with resistance from staff within a medical enterprise, as the changes may require an alteration in existing organisational processes. This resistance can be alleviated by a senior clinician's advocacy of the new technologies (Srinivasan, et al., 2002). Paré et al. (2011, p. 4) denoted further that "when top management is highly involved and supportive of an IT project, greater resources are likely to be allocated to develop and support the new system, enhancing facilitating conditions and ultimately increasing perceptions of organisational readiness". As such, senior clinician support for the implementation of an eHealth system is critical for enterprise-wide adoption. It is thus hypothesized:

H5: The higher the level of senior clinician involvement, the greater will be the propensity to adopt eHealth systems

Bose and Luo (2011) stipulated that financial resource commitment is an antecedent to the adoption and diffusion of information systems within an enterprise. An investment in hardware, software, employee training and system integration is required for the successful implementation of eHealth systems (Zhu, Kraemer, & Dedrick, 2004). Financial resources for subsequent enhancements and on-going expenses that occur during usage should also be budgeted for (Lee & Shim, 2007). Financial constraints place limits on an enterprises' ability to acquire adequate resources required for successful implementation. Financial resources should be devoted as part of a medical enterprise's strategy planning for the development and implementation of ICT system. Failure to do this may result in inadequately implemented systems, systems without the required functionalities or those that do not perform as expected. It is thus hypothesized:

H6: The greater a medical enterprise's level of resource commitment for eHealth system implementation, the greater will be its propensity to adopt eHealth systems.

2.4.4 ENVIRONMENTAL CONTEXT

The external environment context is defined as the arena in which a firm conducts its business, its industry members, knowledge producers, regulators, customers and suppliers (Tornatzky & Fleischer, 1990; Zhu, et al., 2003). These external factors may stimulate innovation adoption and diffusion within an organisations as the organisation responds to competitive pressure, regulatory actions and customer satisfaction requirements (Pan & Jang, 2008).

Companies may adopt a technology voluntarily or due to influences exerted by partners or competitors (Dünnebeil, et al., 2012; Kuan & Chau, 2001; Srinivasan, et al., 2002). Goes and Park (1997, p. 689) found that "hospitals that are linked into multi-hospital systems, regularly exchanged resources with related hospitals and aggressively built institutional affiliations were more likely to adopt innovative services and technologies". In general, medical enterprises form part of a healthcare network and not adopting a technology may exclude them from this network. Exclusion from such networks may result in enterprises failing to maintain a competitive position, a notion confirmed by Iacovou, Benbasat and Dexter (1995) 's recognition of competitive pressure as an adoption driver.

Furthermore, Lee and Shim (2007) posited that eHealth system vendors may play a role in determining the adoption decision. The imposition of vendors creates pressure to use their technology offerings. In addition to this, health consumer based pressure can also drive physicians to adopt technology. Grol (1997) posited that the social interaction between clinical practices allows for patient pressure to influence innovation adoption. This indicates that perceived industry pressures from competitors, partners, vendors and other social influences can influence a medical enterprise's adoption decision.

H7: The greater the perceived external pressure to use eHealth, the greater will be the propensity to adopt eHealth systems

Regulatory support has been recognised as a critical factor affecting innovation diffusion (Zhu, et al., 2003, 2006; Zhu & Kraemer, 2005). Zhu, Kraemer and Dedrick (2004, p.29) defined regulatory support as "ways in which government regulation (laws) could affect innovation diffusion". Although the South African Electronic Communications and Transactions Act of 2002 acts as a regulatory framework for generic electronic data interchange, it is not specific to clinical patient data which requires more stringent rules to ensure that patients is adequately protected when being accessed, stored or transmitted.

eHealth regulations provide medical enterprises with guidelines for storing and processing patient information within ICT systems and define the relevant data and privacy standards. Additionally, medical enterprises can obtain assurance that there are defined regulations to protect their interests when problems from adopting and using eHealth systems occur. A regulated eHealth environment would give medical enterprises assurance that access to application instances and the clinical patient information processed by the systems are adequately protected to decrease the received risk of using the technology. Government can proactively encourage the adoption of eHealth systems (Glynn, Fitzgerald, & Exton, 2005) through law enforcement or other means. When government provides support by means of legislations and regulations for using eHealth systems, medical enterprises will be more inclined to adopt the technology.

Government support for eHealth adoption is not only demonstrated through the definition of legislation, but through their willingness to provide incentives for adopters and subsidies for non-adopters. Many medical enterprises have limited financial resources and require government invention to purchase and implement eHealth systems, such that they not to lag behind their counterparts. Yap, Thong and Raman (1994, p. 201) stipulated that government has a role to play in supporting technology diffusion by creating programmes that "alleviate constraints by providing incentives in the form of financial subsidies". They denoted further that it is not sufficient to rely on solely on market pressures for adoption primarily because medical enterprises in developing countries such as South Africa may desire to adopt but may not have the resources to do so. Alternatively, government may also reward companies who have adopted the technology and have contributed to or shown support for their strategic aims (Department of Health (South Africa), 2012). It is thus hypothesized:

H8: The greater the perception of a supportive eHealth regulatory environment, the greater will be the propensity to adopt eHealth systems.

The proposed control variables for this model are demographic and include location, speciality, and the operating period of the medical organisation. It is necessary to control for

these variables because although demographic factors may not be pertinent to explaining the propensity to adopt, they may have some impact on the dependent variable (Bhattacherjee, 2012). Previous studies have controlled for location (Sloan, Valvona, Perrin, & Adamache, 1986), speciality (Kimberly and Evanisko, 1981) and the operating period (Autio, Sapienza, & Almeida, 2000) and showed that these factors have a potential influence on adoption behaviour. Thus the effects of these demographic factors will be considered and controlled for if necessary.

As aforementioned (Refer to Section 2.3.3), previous studies (Tung, et al., 2008; Viitanen, et al., 2011) have shown that only technological factors influence adoption. Other studies (Simon, et al., 2007) have shown that only organisational studies influence adoption while other studies (Tsiknakis & Kouroubali, 2009) demonstrated the importance of environmental factors. The TOE framework accounts for all TOE factors and each block of variables within the framework influences adoption. It is necessary to understand the individual and overall effects of each block on the propensity to adopt. The cumulative effects of the TOE model will be examined to determine which block of factors improves the model's explanatory power. It is thus hypothesized:

H9a: There is a significant improvement in the explanatory power of the TOE model when technological factors are considered.
H9b: There is a significant improvement in the explanatory power of the TOE model when organisational factors are considered.
H9c: There is a significant improvement in the explanatory power of the TOE model when environmental factors are considered.

CHAPTER SUMMARY

This chapter presented a summary of what is currently in the body of knowledge regarding eHealth adoption. Qualitative studies from the literature review, supplemented with website reviews, were used to derive technologies that constitute eHealth in the South African context, thus addressing the first research question. A description of how eHealth technologies were classified into each healthcare functional area was given. Quantitative studies from the literature review were used as a basis for developing the study's research model. The contributions and shortcomings of existing research were presented which helped in the identification of a research gap. The TOE framework was presented as a theoretical basis for the study and the associated research hypotheses were developed. The hypotheses are summarised as:

Summary
H1: The greater the perceived benefits of eHealth systems, the greater will be the propensity to adopt eHealth systems
H2: The greater the medical enterprises' level of technology competence, the greater will be the propensity to adopt eHealth systems
H3: The higher the perceived complexity of eHealth systems, the lesser will be the propensity to adopt eHealth systems
H4: The larger the size of a medical enterprise, the greater will be the propensity to adopt eHealth systems
H5: The higher the level of senior clinician involvement, the greater will be the propensity to adopt eHealth systems
H6: The greater a medical enterprise's level of resource commitment for eHealth system implementation, the greater will be its propensity to adopt eHealth systems
H7: The greater the perceived external pressure to use eHealth, the greater will be the propensity to adopt eHealth systems
H8: The greater the perception of a supportive eHealth regulatory environment, the greater will be the propensity to adopt eHealth systems.
H9a: There is a significant improvement in the explanatory power of the TOE model when technological factors are considered.
H9b: There is a significant improvement in the explanatory power of the TOE model when organisational factors are considered.
H9c: There is a significant improvement in the explanatory power of the TOE model when environmental factors are considered.

Table 3: Summary of Hypotheses

The next chapter will present the research methodology used to examine the extent of adoption (RQ2) and test the hypotheses presented above (RQ3).

3. CHAPTER 3 : RESEARCH METHODOLOGY

The first section of this chapter outlines the research design and discusses the rationale for its selection. Thereafter, the data collection strategy is presented including the discussion of instrument construction, measurement and sampling. The strategy for testing validity and reliability of the research instruments is then detailed. This chapter then presents the data analysis strategy and the techniques to be used for data analysis are explained. Finally, the chapter discusses the limitations of the research design.

3.1 RESEARCH DESIGN

Various research epistemologies can guide researchers in their approach to problems and investigation of phenomena. The positivist research paradigm is based on the notion that the methods of natural science constitute the only legitimate research methods for use in social science (Lee, 1991). The positivist stance is that "the world of phenomena has an objective reality that can be measured and that relationships between entities in this world can be captured in data that is reasonably representative and accurate" (Straub, Boudreau, & Gefen 2004, p.5). The interpretivist research paradigm maintains that the methods of natural science are inadequate to the study of social reality and takes the position that people, and the physical and social artefacts that they create, are different from the physical reality examined by natural science (Lee, 1991). This approach is subjective and is dependent on the researcher's interpretation of the subject matter. As opposed to positivism, interpretivism doesn't assume the existence of an objective physical and social world that exists independently from humans. The critical research paradigm has an evaluative dimension and aims to "critique existing social systems and to reveal conflicts and contradictions that may inhere within structures" (Orlikowski & Baroudi 1991, p. 19)

A positivist research paradigm was selected to explore relationships between the identified independent variables and the dependent variable, as opposed to the interpretivist and critical research paradigms. Positivism is characterised by formal propositions, their quantifiable measures and their scrutiny of through empirical testing (Hirschheim, 1985). Propositions that can be verified or falsified are posited. The result of proving or disproving these propositions allows researchers to discover relations which can be used to explain or predict patterns of behaviour (Orlikowski & Baroudi, 1991). The propositions may be logically related to each other and must survive attempts aimed to disconfirm them (Lee, 1991).

Positivism is also characterised by using valid, structured instrumentation to investigate the existence of relationships between predefined variables (Straub, et al., 2004). Quantifiable measures of variables are used to test these propositions and draw inferences from a sample to a population (Orlikowski & Baroudi, 1991). Data obtained on a large scale is quantified and analysed to prove or disprove the hypotheses. Propositions are manipulated according to the rules of formal logic and this empirical testing process is value free and has no relation to political, moral or ideological beliefs (Hirschheim, 1985). Conclusions are drawn on mathematical and statistical data obtained from a sample, which is then generalised (Gregor, 2006) to represent the entire population.

The third research objective of this study is to understand multiple factors impacting the adoption of eHealth technologies in the South African healthcare sector. The unit of analysis is the medical enterprise i.e. clinic, general practice, medical centre. Creswell and Clark (2007) denoted that a quantitative approach is best if the research problem identifies factors

that influence the utility of an intervention. A cross-section quantitative study using a structured instrument is deemed appropriate for this study because it measures propensity to adopt based on factors defined within a theoretical framework and gives a generalised overall view of medical organisations' likelihood to adopt eHealth (Pinsonneault & Kraemer, 1993). A qualitative study would give a potentially richer, but less generalisable explanation of individual organisation adoption behaviour. A quantitative approach gives an overall view of the current state of the adoption of eHealth technologies.

The study's objective is to describe large scale organisation behaviour and data is required from a large group of elements to provide an accurate description. This, however, is impossible because of time and resource constraints and data can only be collected from a subset of the population. The survey research method is appropriate for this study because it allows researchers to generalise from a sample to a population so that statistical inferences can be made about some characteristic, attitude, or behaviour of the population (Creswell & Clark, 2007; Pinsonneault & Kraemer, 1993). Apart from giving the researcher the ability to generalise, a key the strength of a survey design is that it allows researchers to examine multiple variables simultaneously and study a problem from multiple perspectives (Bhattacherjee, 2012; Gable, 1994). Surveys, however, cannot demonstrate causation and are subject to respondent biases and researchers should be conscious of these limitations when using them in research (Gable, 1994). To meet the research objective of testing the effects of the identified TOE factors on the propensity to adopt ICTs in healthcare, the survey research design is thus appropriate for this study.

3.2 DATA COLLECTION AND SAMPLING

The study's intention is to study the adoption behaviours of South African medical enterprises. Although online web based instruments embedded as links in emails can access large and geographically distributed populations (Mehta & Sivadas, 1995), they are not as universally appealing and are perceived as unsolicited emails (Evans & Mathur, 2005). Moreover, it has been indicated that response rates using online instruments showed a trend of declining over time (Baruch, 1999; Evans & Mathur, 2005). To compensate for the weaknesses of online data collection methods, a paper based strategy was used to supplement the online data collection method. Using this combined distribution method avoids converting individuals with technical or user problems into non-respondents (Schleyer & Forrest, 2000) and will ensure that attributes of both internet and non-internet populations are represented in the sample obtained.

3.2.1 SAMPLING TECHNIQUES

A combination of probabilistic and non-probabilistic sampling techniques was used to obtain the sample. For the purpose of generalisability, simple random sampling was the sampling technique used to select online respondents. Each element of the sampling frame had an equal probability of being selected. Convenience sampling is a nonprobability sampling technique and elements are included in the sample without pre-specified or known probabilities of being selected (Williams, Sweeney, & Anderson, 2006). Easily accessible medical enterprises were approached and asked to complete the questionnaire. The results obtained using this selection process are unlikely to be representative of the population since the selection is non-random and may have been subjected to sampling bias.

3.3 SAMPLING FRAME

samedicalspecialists.co.za is "an interactive online health directory featuring medical doctors in all fields of expertise including health clinics, hospitals and medical institutions". Medical doctors, specialists and healthcare professionals list their medical enterprises/practices/facilities on this website to promote the services they offer ("SA Medical Specialists : Your Online Medical Specialist Directory", 2013).

A database snapshot of the samedicalspecialists.co.za was taken and a list of clinicians listed on the website was compiled. A total of 1097 professionals or their practice managers or administrators (listed as "office contact" on the website) were identified. The list was then filtered for duplicates using the provided practice number, email or physical address to identify professionals that work for the same organisation. Only one respondent was randomly selected per medical enterprise, practice or facility. 1009 unique practices were identified. Of these, 984 had provided email addresses. Furthermore, of the 25 that had not provided email addresses, 14 had also not provided a fax number and were removed from the frame which meant that there were 995 (i.e. 984 online and 11 fax) potential respondents. The contact information provided was used to determine how the questionnaire would be administered to each potential respondent.

3.4 INSTRUMENT DEVELOPMENT

The instrument to be used to study the propensity to adopt eHealth technology as an IT innovation in healthcare is a structured questionnaire using multi-item 7 point Likert-type scales (1= Strongly Disagree to 7=Strongly Agree) to measure each of the model's independent variables, while a score was computed for the dependent variable. The questionnaire was administered via an online survey system and through paper based distribution methods as detailed below (Refer to Section 3.7). The measurement items were developed by surveying known existing instruments from the IS literature, identifying items and selecting appropriate items based on relevance. The use of the literature as the basis for operationalizing scales will ensure the questionnaire's content validity. Preliminary descriptions of each variable's measures are presented below and are detailed in Table 4. Refer to Appendix I1 for the complete structure of the questionnaire.

3.4.1 INDEPENDENT VARIABLES

Technological context: Perceived Benefits measurement

The construct "Perceived benefits" was measured by using adapted item scales defined by Olhager and Selldin (2003), Hu, Chau and Sheng (2002) and Aaronson, Murphy-Cullen, Chop and Frey (2001). Items were qualitatively analysed and logically grouped as direct or indirect benefits as modelled in the research model.

Perceived Direct Benefits measurement

A key direct benefit of eHealth usage is improved clinician efficiency. Aaronson et al. (2001) defined items: decrease time to review medical history [PDB1], decrease consultation time [PDB2], improve access to patient data [PDB4] and shorten patient on-boarding process and see another physicians patients [PDB5], and these items were used to measure the efficiency-related benefits of eHealth.

The direct benefits of eHealth can also be observed in a medical enterprise's operational area. To measure operations-related direct benefits, the eHealth technology's ability to improve the enterprises' ability to perform reminders for follow-ups [PDB3], streamline billing processes [PDB8] (Aaronson, et al., 2001), reduce service costs [PDB7], manage medical supplies [PDB9] and improve communications with stakeholders [PDB6] (Olhager & Selldin, 2003) was assessed.

Perceived Indirect Benefits measurement

The usage of eHealth may result in positive service-related outcomes. These outcomes include these items: improve staff productivity [PIB1] and reduce unnecessary patient transfers [PIB4] (Hu, et al., 2002). eHealth usage may also result in the improved precision with which clinical staff provide their services, whereby precision is measured by these items: improve clinical documentation [PIB3] and reduce clinical errors [PIB2] (Aaronson, et al., 2001). These items were used to measure the "indirect benefits" second order construct.

Technological context: Technology Competence

IT Infrastructure measurement

Molla and Licker (2005) denoted that having adequate underlying information technology resources influences an organisation's propensity to adopt technology innovations. They stipulated that organisations that have pre-installed interconnected networks [ITI1-ITI3] that allow for seamless information flow are more likely to use of collaborative software applications, as opposed to organisations with standalone systems. Their measurements for IT Infrastructure were adopted for this study.

IT Skill measurement

Medical organisations usually lack the knowledge and technical skills required to support eHealth systems. Thong (1999) and Hung, Hung, Tsai and Jiang (2010) defined indicators of information systems capabilities as a medical enterprises' staff's proficiency with computers [ITS1], the existence of a computer expert [ITS2] within the enterprise and staff's comparative understanding of computers [ITS3]. These items were adopted for this study.

Technological context: Complexity measurement

Complexity has been equated to the "perceived ease of use" variable in the Technology Acceptance Model (Premkumar & Roberts, 1999) defined by Davis (1989). In their study, Chau and Hu (2002) adapted perceived ease of use measures to fit the health informatics context. Similarly, the items: learning to operate eHealth systems would be easy for our clinical staff [CM1]; it is easy for our clinical staff to become skilful in using eHealth systems [CM2] and our clinical staff finds eHealth systems easy to use [CM3] were adapted from Davis (1989) and used to measure complexity in this study.

Organisational context: Size measurement

Zhu et al. (2003) and Thong (1999) found that organisation size is associated with IT investment. In the eHealth system context, size can be interpreted and operationalised to mean the patient base i.e. the number of patients dealt with by the medical organisation on a monthly basis [SI2] (Zhu, et al., 2003). Data about the average number of patients that get treated at the entity was obtained for descriptive purposes. Size was measured by asking the respondents the number of employees within the medical enterprise [SI1]. The adapted scale defined by Premkumar and Roberts (1999) was used to measure this variable.

Organisational context: Senior Clinician Involvement measurement

Senior clinicians can influence the decision of whether technology is adopted and used within the medical enterprise. Srinivasan, Lilien and Rangwaswamy (2002) measured the construct "top management advocacy" and their scale was adapted into the healthcare context to denote the extent to which senior clinicians champion [SCS4] and communicate the importance of new systems [SCS1]. Their item scale also included items which relate to the extent to which senior clinicians encourage the use of technology [SCS3] by highlighting the benefits of technology to their staff [SCS2]. These adapted items were used to measure the construct "senior clinician involvement" in this study.

Organisational context: Resource Commitment measurement

The level of physical and human assets an organisation dedicates to its technology initiatives is vital for successful implementation and use. Daugherty, Autry and Ellinger (2011) did not limit their measurement of resource commitment to financial resources [RC3], but included managerial resources[RC2] which pertained to the assignment of personnel to manage or support technology systems. Their scale was adapted to include the allocation of technology resources [RC1] and these measures were used measure resource commitment in the eHealth context.

Environmental context: External Pressure measurement

Organisations face pressure from various stakeholders and are required to conform to shared notions within the industry. These stakeholders include, but are not limited to patients [EP1-EP3], medical aid companies, equipment suppliers, laboratories [EP4-EP5] and competitors [EP6-EP7]. Srinivasan, Lilien and Rangwaswamy (2002) operationalised institutional influences and included the source of the pressure when defining measures for external pressure. Their instrument was adapted and used to measure external pressure in the eHealth systems context.

Environmental context: Regulatory Environment measurement

Governance and regulation standards for health information ownership in eHealth system environments are not universally applicable. Each country is responsible for defining laws that regulate the use of eHealth. Medical enterprises may be influenced to adopt if there is a supportive regulatory environment for eHealth use. Zhu and Kraemer (2006; 2004) designed items for measuring the extent to which national policies impact adoption. They denoted that government's commitment to promote eHealth [RE2] is indicative of a supportive environment. Additionally, when governments drive the use of eHealth by providing incentives [RE1] and define adequate laws [RE3] that will protect eHealth users when regulatory disputes occur, an environment where medical organisations feel as ease to use the system will be created thus encouraging them to adopt and use eHealth. These items were adapted and used to measure the regulatory environment variable.

Table 4 summarises the sources of the items used to measure each of the constructs.

Variable	Definition	Items	Source of Measurement Items
Perceived Benefits : Perceived Direct Benefits	The degree to which an innovation is perceived better than the idea it supersedes or the anticipated operational advantages that technology can provide an organisation.	PDB1 : Decrease physician time required to review past medical records compared to paper-based records	(Aaronson, et al., 2001; Olhager & Selldin, 2003)
		PDB2: Decrease physician time per patient encounter	
		PDB3: Improve our ability to perform reminders for follow-ups	
		PDB4: Provide more rapid access to patient data than paper-based records	
		PDB5: Help us see another physician's patients more easily	
		PDB6: Improve the way we communicate with medical service providers (i.e. medical equipment suppliers, medical aid companies or labs)	
		PDB7: Reduce the costs of providing patient care and services	
		PDB8: Help us bill for services more accurately	
		PDB9: Improve management of medical supplies	
Perceived Benefits : Perceived Indirect Benefits	The opportunities that emerge from the use of technology.	PIB1: Improve service productivity of medical staff	(Aaronson, et al., 2001; Hu, et al., 2002)
		PIB2: Reduce clinical errors	
		PIB3: Improve accuracy of clinical documentation	
		PIB4: Reduce unnecessary patient transfers or referrals to other healthcare providers	
Technology Competence : IT Infrastructure	The existing technological assets that an enterprise possesses and its extent of computerisation.	ITI1: We have sufficient experience with network based applications	(Molla & Licker, 2005)
		ITI2: Our enterprise is well computerised with networks	
		IT13: Our enterprise has high bandwidth connectivity to the Internet	
Technology Competence: IT Skills and know-how	The presence of personnel with the knowledge and technical capabilities required to support innovation adoption.	ITS1: We are confident that our clinical staff (non-support staff) are proficient with computers	(Hung, et al., 2010)
		ITS2: There is at least one staff member who is a computer expert.	
		ITS3: Our staff's understanding of computers is very good compared with other local medical facilities	
Complexity	The degree to which an innovation is perceived as difficult to understand and use.	CM1: Learning to operate eHealth systems would be easy for our clinical staff.	(Chau & Hu, 2002)
		CM2: It is easy for our clinical staff to become skilful in using eHealth systems	
		CM3: Our clinical staff finds eHealth systems easy to use	

Variable	Definition	Items	Source of Measurement Items
Enterprise Size	An enterprise's headcount or size of their customer or client base.	SI1: Please indicate the total number of employees (healthcare professionals, administrative and support staff) within your medical enterprise SI2: Please indicate the average number of patients serviced at this medical enterprise/practice on a monthly basis	(Zhu, et al., 2004)
Senior Clinician Involvement	The efforts that senior clinicians take to emphasize the importance of organisational responsiveness to new technologies.	SCS1: Our senior clinicians (clinicians in charge of this practice) communicate the importance of the medical enterprise gearing up to meet changing technology trends.	(Srinivasan, et al., 2002)
		SCS2: Senior clinicians make an effort to convince other staff members of the benefits of new technology.	
		SCS3: Senior clinicians encourage other staff members to use new technology systems.	
		SCS4: Senior clinicians in this practice are frequently the most ardent champions of new technology systems.	
Resource Commitment	The extent to which tangible and intangible enterprise resources are devoted to the implementation, use and support of technology systems.	RC1: Our medical enterprise has the technological resources required to make use of eHealth systems	(Daugherty, et al., 2011)
		RC2: Our medical enterprise has the managerial resources (assignment of personnel to manage or support eHealth systems) to make use of eHealth systems	
		RC3: Our medical enterprise has the financial resources to make use of eHealth systems	
External Pressure	The extent to which forces from constituencies in the environment influence technology adoption decisions.	EP1: Some of our patients demand that we implement eHealth systems	(Srinivasan, et al., 2002)
		EP2: Our relationships with our patients will suffer if we do not implement eHealth systems.	
		EP3: Our patients' needs have a strong influence on the eHealth systems we implement	
		EP4: Having state-of-the art eHealth systems confers status for our medical enterprise with our stakeholders (medical aid companies, equipment suppliers, laboratories, etc.)	
		EP5: Our stakeholders (medical aid companies, equipment suppliers, laboratories, etc.) would perceive our practice/facility as being technologically backward if we did not implement eHealth systems	
		EP6: If we do not undertake eHealth initiatives, we might lose our edge over competing practices/facilities in the area.	

Variable	Definition	Items	Source of Measurement Items
		EP7: Being ahead of other competing practices/facilities in the use of e-Health is one of our key objectives	
Regulatory Environment	The degree to which government policies affect innovation diffusion.	RE1: Government is adequately driving the use of eHealth systems by providing incentives	(Tan, et al., 2007; Zhu, et al., 2006; Zhu, et al., 2004) (adapted)
		RE2: Government demonstrates a strong commitment to promote the use of eHealth	
		RE3: There are effective laws (e.g. with regard to privacy of patient information) that support eHealth	

Table 4: Questionnaire construction summary

3.4.2 DEPENDENT VARIABLE

Propensity to Adopt Measurement

Propensity to adopt was operationalised as the total number of technology innovations that a medical practice had implemented. Sahadev and Islam (2005) used a weighted formula to calculate the propensity to adopt variable a formula that computed a sum, which accounted for organisation age, and the difference between the length of time that the technology has been available on the market and the length of time since the organisation has been using the technology. This approach requires respondents to know how long all adopted systems have been in place and this weighting data may be difficult to obtain. It was decided that, a simplified, un-weighted score would be computed, as done in the study by Thong (1999). This is because preliminary pilot testing indicated that a few organisations could accurately report the time period in which the technologies had been in use. Fourteen binary items were presented, each representing an eHealth Technology (Refer to Section 2.3.2, p. 14 and Figure 3 for the list of technologies). The total number of "yes" responses was used as the overall measure for propensity to adopt and the propensity to adopt score will be a score between one and fourteen.

In addition to the calculation of the adoption score, this study also follows previous studies (Beatty, Shim, & Jones, 2001) that categorised enterprises' by adoption stage in the diffusion cycle (i.e. pioneer, early adopter, early majority, late majority, laggards). This study examines a range of technologies with different diffusion cycle periods and will use the same categorisation scheme. An enterprise may be an early adopter of one technology but a late adopter of another. In addition to this, the categorisation of medical enterprises as either non-adopters, low, medium or high adopters will be used to for reporting purposes (Namasivayam, Enz, & Siguaw, 2000). This categorisation is often used when studying the adoption of a range of technologies as it describes the degree to which a medical enterprise has adopted the fourteen technologies and is therefore appropriate for this study.

3.4.3 DEMOGRAPHIC DATA

Respondents were required to provide demographic data in order to determine or confirm their eligibility to complete the questionnaire on the enterprise's behalf. Respondents were required to indicate their role in the organisation, the length of time they had been working in the medical enterprise (i.e. tenure) and the length of time they had been in their role (level of experience).

Additionally, respondents were required to provide information about their medical enterprise. This included the length of time that the enterprise had been in operation (i.e. organisation age), the enterprise's location and its speciality. For analysis and reporting purposes, speciality was recoded into primary, secondary or tertiary medical enterprises. Primary medical enterprises are enterprises that act as first point of consultation and provide patients initial entry into the healthcare system. Secondary medical enterprises are dedicated to disease management and require a referral from a primary professional while tertiary medical enterprises offer highly specialised medical services. Respondents were allowed to choose more than one speciality. Refer to Table 5 which details how the specialities were coded into categories.

Speciality Category	Speciality
Primary	General/Family Medicine, Dental Therapy and Oral Hygiene, Optometry & Dispensing Opticians, Chiropractic Therapy, Gynaecology, Podiatry, Paediatrics, Homeopathy, Health Promotion
Secondary	Dietetics and Nutrition, Occupational Therapy, Medical Orthotics & Prosthetics, HIV Specialists, Orthodontists Physiotherapy, Bio-kinetics, Psychology, Psychiatry, Audiology / Speech, language and hearing, Emergency care, Pathology, Dermatology
Tertiary	Ophthalmology, Otorhinolaryngology (ENT Specialists), Pulmonology, Neurology, Cardiac surgery, Internal medicine, Endocrinology, Sub-acute hospital care, Genetics, Gastroenterology, Anaesthesiology, Plastic and reconstructive surgery, Orthopaedic surgery

Table 5: Data coding for medical enterprise speciality.

3.5 PRE-TEST

The survey instrument was subjected to pre-testing to enhance face validity. Two senior Information Systems lecturers reviewed the questionnaire. Modifications to the questionnaire were made based on their suggestions. Ambiguous questionnaire items were identified and clarified i.e. unclear statements were rephrased. Although items were added for some variables and deleted for others, total number of questionnaire items was reduced as the questionnaire was regarded as too long. Minor changes were made to the design, structuring and ordering of the questionnaire. Refer to Appendix G for the complete list of changes made to questionnaire items after the pre-test.

3.6 PILOT TEST

Pilot tests are conducted to "further improve the scales, to determine problems in completion of the instrument and to estimate the time required to complete the questionnaire" (Taylor & Todd 1995, p. 154). Pilot test participants are required to have an organisation profile similar to that of the main study's participants, thus one hundred random records were selected from the sampling frame. All the selected potential participants had provided email addresses and the online data collection strategy was used. The paper-based data collection strategy was used in the follow-up process. Questions about the questionnaire were posed to the respondent to identify weaknesses in the survey design. Respondents were given the opportunity to provide qualitative comments about the instrument items and to suggest ways to improve it.

The following instrument-related questions were posed at the end of the pilot-test questionnaire (Zhang, 2011):

a. Were the questions easy to understand? Were any questions unclear to you?
b. How long did it take you to complete this survey? Please comment of the length of the survey (whether it was too long or too short) and suggest possible ways of addressing this.
c. Was the survey clearly laid out? Please specify which parts were unclear.
d. Did you find the survey questions comprehensive enough? Do you feel any relevant issues have been missed?

e. Are the instructions for completing each part of the survey clearly written? Which questions were not clearly expressed?

The pilot test resulted in the questionnaire being tested on six of the 100 medical organisations who were invited to participate (response rate of 6%). A high level analysis of the variability in the responses obtained from the pilot test was done to check whether respondents interpreted the items in the same way. This resulted in the identification of questions that were inconsistent and difficult to answer. Refer to Table 6 for the items that were re-worded to improve intelligibility.

Item Code	Item Pre Pilot test	Item Post Pilot test	Changes made and Rationale
PDB1	Decrease physician time required to review past medical records	Decrease physician time required to review past medical records compared to paper-based records	Item expanded with detail
PDB3	Improve our ability to perform chart checks/reminders for follow-ups	Improve our ability to perform reminders for follow-ups	Item simplified and multiple response dimension (i.e. choice between chart checks and reminders) removed
PDB4	Provide more rapid access to patient data	Provide more rapid access to patient data than paper-based records	Item expanded with detail
ITS1	All clinical staff (non-support staff) are computer literate	We are confident that our clinical staff (non-support staff) are proficient with computers	Use of pronoun reviewed
SCS1	Our senior physicians (physicians in senior management positions) communicate the importance of the medical enterprise gearing up to meet changing technology trends.	Our senior clinicians (clinicians in charge of this practice) communicate the importance of the medical enterprise gearing up to meet changing technology trends.	Use of noun reviewed to make it easier for all potential respondents to identify with the questions *
SCS2	Senior physicians make an effort to convince other staff members of the benefits of new technology.	Senior clinicians make an effort to convince other staff members of the benefits of new technology.	*
SCS3	Senior physicians encourage other staff members to use new technology systems.	Senior clinicians encourage other staff members to use new technology systems.	*
SCS4	Senior physicians in this practice are frequently the most ardent champions of new technology systems.	Senior clinicians in this practice are frequently the most ardent champions of new technology systems.	*
RC1	Our medical enterprise has the technological resources required to adopt eHealth systems	Our medical enterprise has the technological resources required to make use of eHealth systems	Item re-worded, "make use of" used instead of "adopt" **
RC2	Our medical enterprise has the managerial resources (assignment of personnel to manage or support eHealth systems) to adopt eHealth systems	Our medical enterprise has the managerial resources (assignment of personnel to manage or support eHealth systems) to make use of eHealth systems	**
RC3	Our medical enterprise has the financial resources to adopt eHealth systems	Our medical enterprise has the financial resources to make use of eHealth systems	**

Table 6: Pilot Test results

It was noted that respondents had not provided the information regarding the length of time that each technology had been in use (required for descriptive statistics). The instructions were modified and a response option was added to allow respondents to indicate that they

couldn't provide the information requested because they had no knowledge thereof. This was done to differentiate missing data obtained because of a lack of knowledge and missing data obtained because the respondent opted not disclose the requested information.

The lack of variability in responses to the size variable was also noted. The scale defined by Premkumar and Roberts (1999) was adapted and medical enterprises with less than five employees (as per the original scale) were labelled to differentiate single practitioner practices (1-2 employees) from medium-sized medical practices (3-5 employees).

The final questionnaire is shown in Appendix I1.

3.7 ADMINISTRATION OF THE INSTRUMENT

Following the pilot test, the final questionnaire (Appendix I1) was then administered in the field. Online and paper based (faxed and hand-delivered) surveys were distributed to medical enterprises such as physician practices, family health teams, medical facilities, single and multi-specialty medical groups, medical centres and clinics, to determine their awareness of and their likelihood to adopt the cluster of eHealth technologies. An electronic version was emailed to the list of companies identified in the sampling frame. Personalised emails, with a cover letter (refer to Appendix H) were sent to a representative of the medical enterprise, inviting the potential respondent to participate in the study. This invitation included a link to the online instrument.

The survey is intended for the strategic IT decision makers within these enterprises (i.e. those whose responsibility is to guide and authorise the procurement of eHealth systems for the organisation). These key informants were a health IT manager, operations manager, administrator or clinician, depending on the size of the organisation (Heathfield, Pitty, & Hanka, 1998). Respondents were informed that they had the option to complete the questionnaire using their preferred method (i.e. complete paper-based or online forms).

Faxed forms were sent to potential respondents that had not provided an email address or those who had been invited to participate online, but preferred a paper-based method. Hand-delivered forms were delivered to practices that were in the sampling frame and to an additional identified convenience sample of 50 medical enterprises. To prevent respondent time pressure, forms were returned via pick up, scan/email, mail or fax. A copy of the online instrument was created and used to capture data from the paper based forms. This was done to minimise the probability of data capturing errors.

Respondents who received hand-delivered forms who did not have time constraints opted to complete the questionnaire in the presence of the researcher and had the option to ask for clarification and explanations or discuss any aspect of the study. Creswell and Clark (2007) denoted that in order for researchers to provide an accurate interpretation of data, "debriefing" between the researcher and participants in quantitative research may be required. Furthermore, Campanelli, Martin, Rothgeb (1991) denoted that the prohibition against interaction with respondents undermines the quality of data, where data quality is measured by the percentage of missing items. Respondents were impartially debriefed and allowed to complete the questionnaire independently.

Frequency counts were examined (using an online survey tool) halfway through the data collection process, after all initial invitation emails had been sent. It was observed that only a

few responses from regions other than Gauteng had been obtained. Telephonic reminders to medical enterprises based outside the Gauteng region were made to ensure that responses were obtained from all provincial regions of South Africa. These were followed up with reminder emails if requested by the potential respondent. Potential respondents in the Gauteng region were only sent reminder emails, provided they had not already participated in the study. Due to time and resource constraints, only a single batch of personalised reminder emails was sent.

3.8 DATA ANALYSIS STRATEGY

Data will be analysed using the statistical software package SPSS (version 21). Primary data will be screened for missing data and outliers to identify problematic cases. Missing data will be imputed using a mean-value substitution strategy. Outliers will be detected by computing standardised scores to determine whether any responses are more than 3 standard deviations from the mean and therefore considered extreme.

The validity of the measurement scales will be tested. Construct validity is the extent to which a scale or set of measures accurately represents the concept of interest (Hair, Black, Babin, Anderson, & Tatham, 2006). In addition to the use of literature as a basis for construct operationalization (content validity) and the use of a pilot test to confirm face validity, construct validity is additionally assessed through tests of convergent and discriminant validity. Convergent validity refers to "the closeness with which a measure relates to (or converges on) the construct that it is purported to measure" or "the degree to which two measures of the same concept are correlated" (Bhattacherjee 2012, p. 59 ; Hair, et al., 2006). Discriminant validity refers to "the degree to which a measure does not measure (or discriminates from) other constructs that it is not supposed to measure" or "the degree to which two conceptually similar concepts are distinct" (Bhattacherjee 2012, p. 59; Hair, et al., 2006).

Factor analysis is a statistical method used to test the convergent and discriminant validity of scales and to determine if the items measure the construct appropriately (Aladwani & Palvia, 2002). More specifically, Principal Components Analysis (PCA), a data reduction technique which reduces a larger set of measures to a smaller, more manageable number of composite variables, will be used to confirm convergent and discriminant validity. Convergent validity will be confirmed if multi-item scales show uni-dimensionality and items that are meant to measure a single construct load highly onto a single component. Discriminant validity will be confirmed if items have low cross-loadings and each factor loads highly on its associated construct than on any other construct.

The reliability of the measurement scales will also be tested. Internal consistency reliability is a measure of consistency between different items of the same construct (Hair, et al., 2006). If a multiple-item construct measure is administered to respondents, the extent to which respondents rate those items in a similar manner is a reflection of internal consistency (Bhattacherjee, 2012). Cronbach's alpha values will be computed for each construct and they will be deemed reliable if the alpha coefficient is greater than 0.700.

Data will be analysed descriptively (demographic data) and inferentially (hypothesis testing). Data will be tested for the assumptions underlying multivariate techniques to ensure that the

appropriate inferential statistical technique is selected (i.e. assumptions of multiple regression).

Multiple regression analysis is an analytical method used to describe the relationship between a dependent variable and multiple independent variables. A hierarchical regression model in turn tests how strongly each independent variable influences the dependent variable and will be used as a data analysis technique in this study. Each variable is entered incrementally, starting with the control variables (Leonard-Barton & Deschamps, 1988). The proposed control variables for this model are demographic and include location, speciality, and the operating period of the medical organisation (with younger organisation having been established in the last decade), and are held constant during the regression analysis.

The beta value (β) is a measure of how strongly each independent variable influences the dependent variable. Each regression coefficient represents an estimate of the change in the dependent variable, when all other independent variables are held constant. A regression equation of the form $E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ...+\beta_p x_p + \epsilon$ is developed. The adjusted R^2 is the variability in the dependent variable that can be explained by the multiple regression equation (Williams, et al., 2006).

Because hypothesis tests are based on a sample, there is a possibility that errors may occur. Type I errors occur when the null hypothesis is rejected when it is true and Type II errors occur when the null hypothesis fails to be rejected when it is false. The level of significance (α) is the probability of making a Type I error and is pre-defined at 0.05. An F test will be used to determine whether a significant relationship exists between the dependent variable and the set of all the independent variables (overall significance). The null hypothesis, (H_0) would be that all the beta coefficients are zero and the alternative being ($H_{a)}$ that not all coefficients are equal to zero. A p-value approach will be used to determine statistical significance and H_0 will be rejected if the p-value is less than α (i.e. $p < 0.05$). The research hypothesis will be supported if there is a statistically significant relationship between the independent variable and the dependent variable.

3.9 ETHICAL CONSIDERATIONS

Research conducted in the information systems and healthcare sector requires a level of ethical professionalism to safeguard the interests of the research participants. Studies in health informatics, undertaken at the University of the Witwatersrand are required to comply with the conditions stipulated by the research ethics committee of the School of Economic and Business Sciences. Research is approved if conditions of informed consent, anonymity and confidentiality are met.

3.9.1 INFORMED CONSENT, VOLUNTARY PARTICIPATION AND RIGHT TO WITHDRAW

The cover letter informed the potential participants of the aims and objectives of the study. They were notified that participation in the study is entirely voluntary and that they would not incur any penalties of losses if they did not participate. Furthermore, they were informed that completion of the survey would be taken to be their informed consent. Potential respondents were also reminded that they had rights to the data provided and may at any stage, request to withdraw the data provided if they are inclined to do so.

3.9.2 CONFIDENTIALITY, ANONYMITY AND REPORTING

The cover letter also informed the potential participant that information is anonymously provided. No information that can be used to identify the medical practice was requested and responses could be not traced back to an individual organisation. No patient data was required during the survey and hence patient data confidentiality is not at risk of being compromised, which would have in turn compromised the physician-patient or organisation-patient relationship. Data obtained will be kept confidential and not be disclosed to any third parties including patients/clients of the surveyed practices. Data is reported in the aggregated and the raw individual responses are stored securely and will not be accessible to anyone other than the researcher and her supervisor.

The study was approved unconditionally by the School of Economic and Business Sciences with protocol number CINFO/1022 (Refer to Appendix J).

3.10 METHODOLOGICAL LIMITATIONS

A quantitative research approach was used to determine the impact of various factors on the propensity to adopt technology. Online and paper-based surveys were distributed to and completed by health IT managers, administrators and health practitioners. Surveys provide surface level analyses and may be sample and context specific. Thus, the study has methodological limitations which are discussed below:

Andrews, Nonnecke and Preece (2003) stated that employing the electronic survey methodology attempts to reach a hard to involve population of participants. Since the online the survey is web-based, access to the survey was limited to organisations that have access. Medical enterprises without access were therefore excluded. Thus the web based survey would have only reached users who have access to and are therefore already using some forms of ICTs within their organisations. This is not necessarily representative of the population of medical enterprises in the country and thus limits the generalisability of the results of the survey. Although hand-delivered and faxed forms were sent to try to mitigate these limitations, due to resource constraints, the paper-based forms only reached a convenient sample of practices based in the suburban and urban areas of Gauteng. Thus limitations to the representativeness and generalisability of the results remain (Baroudi & Orlikowski, 1989; Chung & Tan, 2004).

The data was also self-reported thereby relying on the honesty of the respondent. Despite promises of confidentiality, the self-reports may be influenced by reluctance of participants to honestly disclose organisational data or their inclination to provide socially desirable responses (Podsakoff & Organ, 1986). Self-reports also raise the issue of common method variance (i.e. variance that is attributable to the measurement method rather than to the constructs the measures represent) (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Moreover, the surveys were self-administered. Thus as opposed to interactive interviews, further explanations to misunderstood questions could not be provided. Thus a risk, of the respondent not providing an accurate response to a misunderstood question, exists.

Although the survey invitations were directed at clinicians, practice managers and practice administrators were also eligible respondents and could participate in the survey. Thus, respondents can fill varying roles within the medical enterprise. The difference in the type of respondent may have influenced the results of the survey. Additionally, it cannot be assured

that the online respondent identified themselves honestly as an IT manager, practice administrator or clinician who is responsible for procuring eHealth applications.

CHAPTER SUMMARY

This chapter detailed the research design used to address the research questions and the selection of the quantitative research approach was justified. It then gave a description of the data sources, sampling and analysis techniques to be used. Details of how the questionnaire was constructed were given. The techniques used to ensure validity and reliability (i.e. pre- and pilot testing, factor analysis, internal consistency reliability) were introduced and explained. Finally, the study's methodological limitations were discussed. In the next chapter, data is analysed and the findings of the study are reported.

4. CHAPTER 4 : DATA ANALYSIS

This chapter presents the findings of this study. Firstly, the chapter reports the results of the data screening process and presents the results of missing data and outlier analyses. Secondly, a profile of the responding medical enterprises is given. Thirdly, the chapter answers the second research question by giving a description of the current state of eHealth adoption within South African medical enterprises. The third research question is then addressed. This requires that the validity and reliability of the measures are examined and the research model and hypotheses tested.

4.1 DATA SCREENING

A total of 138 responses were received after 11 weeks of data collection. Given that there were 995 potential respondents, a response rate of 13.87% was obtained. In their study, Baruch and Holtom (2008) found that the average response rate for studies that utilized data collected from organizations was 35.7% with a standard deviation of 18.8. The response rate obtained in this study is regarded as low and has been noted as one of this study's limitations. However, the 138 responses have provided sufficient data to allow for statistical tests of the study's hypotheses.

4.1.1 MISSING DATA

Responses with missing data may distort the data analysis process. Data was thus screened for missing values. Of the 138 responses received, two were disregarded as they were partially completed. Four of the responses had five or more items missing per case, which accounted for 10% or more of the expected data and were subsequently deleted from the dataset. Twenty-one cases had one item missing and two cases had two items missing. There was no observable pattern to the missing data and data was thus considered missing at random. A mean replacement strategy was used to impute the missing data due to the small number of missing values per item.

Number of Missing Data Values per Case	Number of Cases	Resolution
0	109	N/A
1	21	Mean-substitution
2	2	Mean-substitution
5	1	Omitted
7	2	Omitted
14	1	Omitted
>14 (partially completed)	2	Omitted

Table 7: Missing data

Refer to Table 8 for items that had missing values which were imputed using a mean-substitution strategy.

Variable	Number of Replaced Missing Values
PDB3	1
PDB4	1
PDB5	2
PDB8	1
PDB9	1
PIB2	2
PIB3	1
PIB4	1
ITI1	1
ITS2	1
ITS3	1
CM2	1
CM3	1
SCS1	1
SCS3	1
SCS4	1
RC2	1
EP2	1
EP3	1
EP7	1
RE1	1
RE2	2
TOTAL	25

Table 8: Items with missing data

4.1.2 OUTLIER DETECTION

Outliers are observations with unusually large or unusually small values or are distinctly different from other observations. Standardised z-scores can be used to identify outliers (Williams, et al., 2006). Standardised z-scores were computed for each item (i.e. the z-score for *i*th observation $z_i = (x_i - \overline{x})/s$ where x_i is the *i*th observation, $\overline{x}$ is the sample mean and *s* is the sample standard deviation). Records were removed if they had standardised z-scores less than -3 or greater than 3 on more than one questionnaire item (i.e. within 3 standard deviations from the mean). Two outlying observations were identified and the records were subsequently omitted from the dataset leaving 130 usable responses for the study.

4.1.3 POOLING

After screening for missing data and outliers, 130 responses remained. 70% of the responses were completed using the online distribution method while the remaining 30% were either faxed or hand delivered.

A Mann-Whitney-U test was done to determine whether the responses obtained using the two distribution methods differed in enterprise size.

TEST STATISTICS	
	SIZE
Mann-Whitney U	1404.000
Wilcoxon W	5590.000
Z	-1.991
Asymp. Sig. (2-tailed)	.046

The comparison across enterprise size shows the p-value was significant at 0.05 level. This finding is not entirely unexpected as the paper-based method was used for a convenience sample of mostly small practices in the Gauteng area.

A chi-square test was done to determine whether the responses obtained using the two distribution methods differed significantly with respect to medical enterprise speciality.

		DISTRIBUTION METHOD		Total
		Online	Paper	
SPECIALITY	Primary	33	23	56
	Secondary	42	12	54
	Tertiary	16	4	20
Total		91	39	130

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.777[a]	2	.056
Likelihood Ratio	5.763	2	.056
N of Valid Cases	130		

An independent samples t-test was done to determine whether the propensity to adopt responses differed across the two distribution methods.

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PROPENSITY TO ADOPT	Equal variances assumed	1.717	.192	.459	128	.647	.198	.431	-.654	1.050
	Equal variances not assumed			.433	63.311	.667	.198	.457	-.716	1.111

Comparisons across the speciality levels and the propensity to adopt scores were, however, not significant. Thus, the responses obtained using the online and paper distribution methods are not considered different from each other and are pooled. The sample profile is presented next.

4.2 SAMPLE PROFILE

The questionnaire respondents were qualitatively classified as either clinicians, practice managers or practice administrators based on their job title or role within the medical enterprise. 74.6% of the responses were obtained from clinicians. The respondents had, on average, been in their roles for 11 years and had been working in the healthcare sector for 11 years. The average medical organisation had been in operation for 13 years, thus the average respondent was well established in their role in the enterprise.

4.2.1 ORGANISATION DEMOGRAPHICS

Demographic data was examined to ascertain the heterogeneity of the responding organisations. Analysing this information warrants that no subgroups are excluded and different aspects of the population are represented in the sample.

The data shows that all types of medical enterprises are well represented in the sample with primary medical enterprises (e.g. General Medicine, Dental, Gynaecology practices, etc.) constituting 43% of the sample responses followed closely by secondary level medical enterprises (e.g. Orthodontic, Psychology, Occupational Therapy practices, etc.) at 42% with a fair number of tertiary enterprises (e.g. Anaesthesiology, Ophthalmology, Endocrinology practices, etc.) at 15%.

Speciality Group	Frequency	Percent	Cumulative Percent
Primary	56	43.1	43.1
Secondary	54	41.5	84.6
Tertiary	20	15.4	100
N	130	100	

Table 9: Respondent Profile: Speciality

Eight of the nine provinces were represented in the sample. 65.4 % of the responding medical enterprises were located in the Gauteng area which hosts 24% of South Africa's total population (Statistics SA, 2013) and is the most populated region in the country. The data collection strategy contributed to this over-representation of Gauteng medical enterprises and it is acknowledged as a potential limitation that findings may not be generalisable to the less represented geographic areas.

Province	Frequency	Percent	Cumulative Percent
Gauteng	85	65.4	65.4
Mpumalanga	1	0.8	66.2
North-West	2	1.5	67.7
Northern Cape	1	0.8	68.5
Western Cape	24	18.5	86.9
Eastern Cape	1	0.8	87.7
Free-State	3	2.3	90
KwaZulu-Natal	13	10	100
N	130	100	

Table 10: Respondent Profile: Location

Of the responding enterprises, 36.2% were single practitioner practices and 38.5% were medium sized practices. The remaining responses were obtained from larger practices, clinics, medical centres and hospitals.

Number of Employees	Frequency	Percent	Cumulative Percent
1-2	47	36.2	36.2
3-5	50	38.5	74.6
6-10	16	12.3	86.9
11-15	2	1.5	88.5
16-20	4	3.1	91.5
21-25	3	2.3	93.8
More than 25	8	6.2	100
N	130	100	

Table 11: Respondent Profile: Size (Number of Employees)

The data shows that the responding medical enterprises treat, on average, 323 patients per month. The patient-base was transformed into categories by splitting data into quintiles.

Patients Per Month	Frequency	Percent	Valid Percent	Cumulative Percent
Very Small (<= 40)	27	20.8	21.3	21.3
Small (41 - 100)	25	19.2	19.7	40.9
Medium(101 - 200)	28	21.5	22	63
Large (201 - 400)	24	18.5	18.9	81.9
Very Large (401+)	23	17.7	18.1	100
Total	127	97.7	100	
Unreported	3	2.3		
N	130	100		

Table 12: Respondent Profile: Patient base

The data shows that the responding medical enterprises had, on average, been in operation for 13 years. The youngest enterprise had been operating for a year and the oldest, forty. The organisation operating period was transformed into categories by using normative splits (defined by decade). Most of the responding medical enterprises (51.5%) had been established in the past decade (1994-2013).

Age (years)	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 10	67	51.5	52.3	52.3
11-20	35	26.9	27.3	79.7
21-30	18	13.8	14.1	93.8
More than 30	8	6.2	6.3	100
Total	128	98.5	100	
Unreported	2	1.5		
N	130	100		

Table 13: Respondent Profile: Operating Period of Medical Enterprise

4.3 STATE OF EHEALTH ADOPTION WITHIN SOUTH AFRICAN MEDICAL ENTERPRISES

Respondents were asked to indicate (if known) the length of time that they had been using each of 14 eHealth technologies within three of the four functional areas (business management, clinical informatics and patient information storage systems). Table 14 presents the number of respondents who reported the length of time that each eHealth system had been in use within their enterprise. The mean, minimum and maximum periods in use are reported in the right hand columns of the table.

This data was used to determine the rate of adoption and to illustrate the diffusion patterns of each technology. Frequency counts were used to count the number of users that had adopted the technology in each year. The cumulative number of users was computed year-on-year since initial adoption and the resulting data was used to plot diffusion curves. Refer to Appendix K for an example of the SPSS output, which illustrates a frequency count table (appended with the calculated cumulative number of users data) that was used to plot the curves.

Functional Area	eHealth System	In Use	Percentage In Use*	N**	Response Percentage***	Mean	Minimum	Maximum
Healthcare Business Management Systems	Electronic medical aid claims submission systems	84	64.6	56	66.7	8.321	1	30
	EFT (Electronic Fund Transfer) systems	120	92.3	79	65.8	8.563	1	30
	Practice administration information systems	47	36.2	27	57.4	7	1	20
	e-Prescription systems	4	3.1	4	100	8.5	3	16
	Business Productivity software	108	83.1	66	61.1	9.598	1	32
	Electronic records for patient financial and fee related information	110	84.6	81	73.6	9.648	1	32
Professional Clinical Informatics	Clinical decision support systems	24	18.5	15	62.5	8.667	2	20
	Online medical reference / knowledge repository	58	44.6	42	72.4	7.071	1	20
	Electronic ordering of laboratory tests	7	5.4	3	42.9	4.333	1	10
	Electronic ordering of imaging tests	13	10	9	69.2	9.111	2	18
	Electronic records for patient assessment /clinical notes	47	36.2	31	66	6.911	0.3	30
	Electronic access to laboratory tests results	34	26.2	23	67.6	4.804	0.5	20
Patient Information Storage Systems	Electronic records for patients' demographic related information	77	59.7	55	71.4	9.464	1	32
	Electronic access to imaging test results	35	26.9	24	68.6	4.958	1	15
Consumer Health Informatics†	-	-	-	-	-	-	-	-

Table 14: Summary: Diffusion Data

* Percentage of total medical enterprises who were using the technology (n=130)
** Number of medical enterprises that reported the length of time the technology was in use
*** Percentage of Medical enterprises that reported the length of time the technology was in use
† The Consumer Health Informatics functional area (Figure 3) was not included in the basket of applications studied

The cumulative number (or percentage) of adopters over time indicates the level of adoption. Rogers (2010, p. 22) defined five levels of adoption and described these levels as "the classifications of the members of a social system on the basis of innovativeness, the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system". The adoption levels were defined as Innovator (0% – 2.5% cumulative adopters), Early adopter (2.6% – 16 % cumulative adopters), Early Majority (17 % – 50 % cumulative adopters) Late Majority (51% – 84% cumulative adopters) and Laggards (85% – 100% cumulative adopters) (Rogers, 2010). Cumulative adopter distributions approach a sigmoid curve ("S" shaped curve) over time as depicted in Figure 5. The curve levels off when no new adopters are observed and the saturation phase is reached.

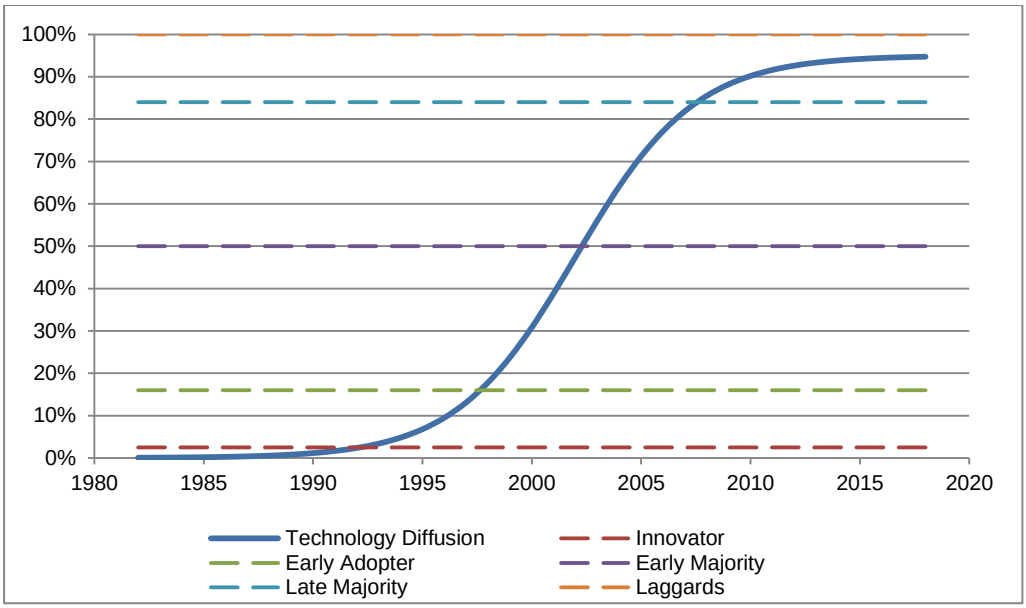


Figure 5: Diffusion Curve

For each functional area of eHealth technology, the diffusion curves are presented below. The functional areas were discussed in Sections 2.3.1 and 2.3.2. The graphs approximate exponential curves and this indicates that the technologies are either in the innovation, early adoption, early majority; late majority or laggard phases of diffusion. None of the technologies had reached the saturation phase as the graphs did not indicate levelling off and did not display a sigmoid (an S shape) curve (as depicted in Figure 5).

The data and graphs indicate that of the business management eHealth technologies, EFT Systems are the most diffused systems (92.3%)[2] and are in the laggard phase of adoption (min=1; max 30; mean=8.563 years)[3] while ePrescription systems are the least diffused (3.1%) and are in the early phases of adoption (min=3; max 16; mean=8.5 years).

[2] Percentages are based on the total number of medical enterprises who were using the technology (N=130)
[3] Reported time in use: Min=Shortest time in use; Max=Longest time in use; Mean=Average time in use

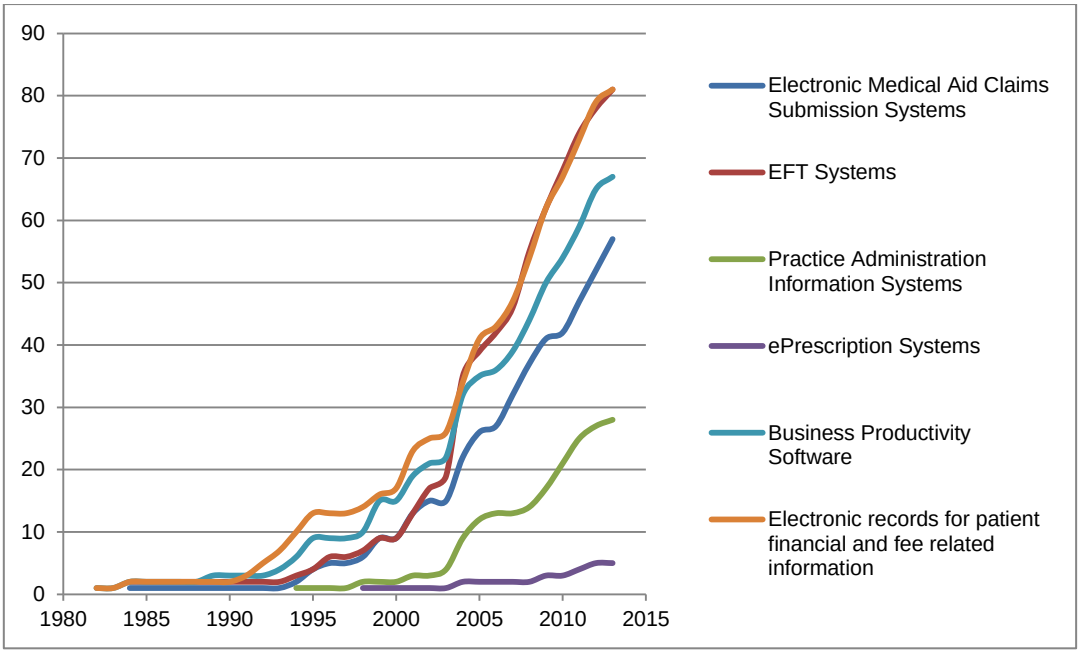


Figure 6: Health Business Management diffusion graph[4]

In the area of clinical informatics, the graphs illustrate that online medical reference systems are increasingly being adopted (44.6%) and are in the early majority phase of adoption (min=1; max=20; mean=7.071 years) as opposed to systems for ordering laboratory tests (5.4%) which are still in the early adoption phase (min=1; max=10; mean=4.333 years).

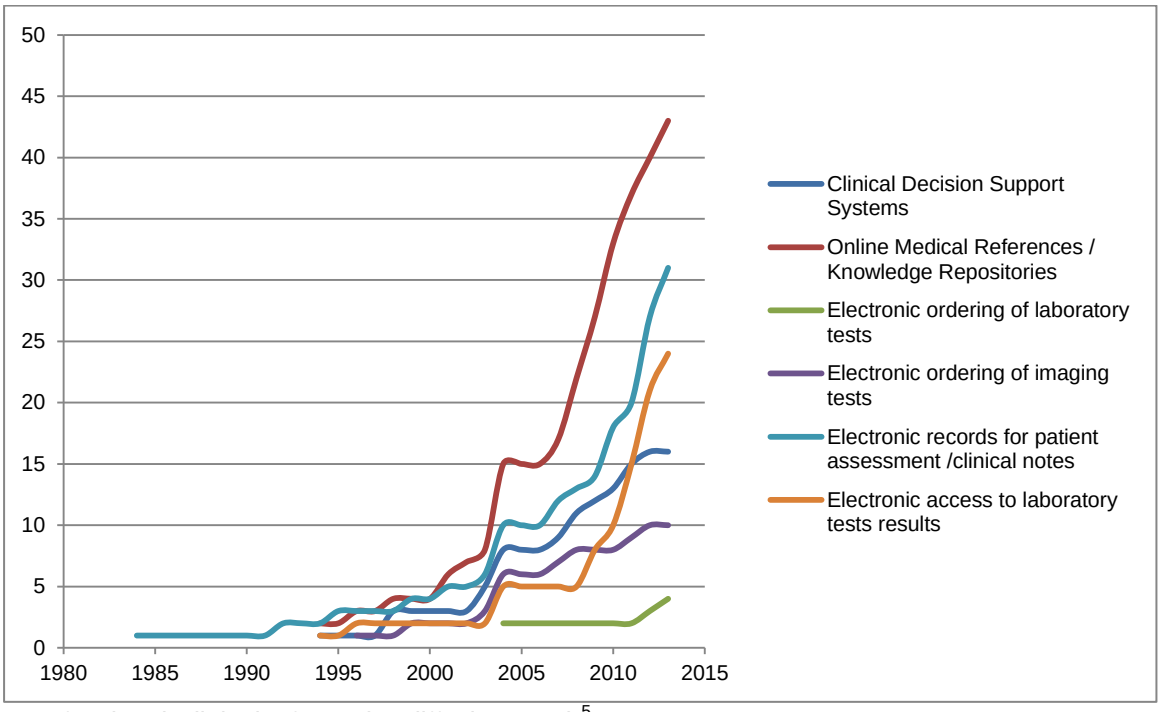


Figure 7: Professional Clinical Informatics diffusion graph[5]

[4] Health business management system diffusion curves based on number of medical enterprises that reported the length of time the technology and not total number of adopters in sample (refer to Table 14 field N**)
[5] Professional Clinical Informatics diffusion curves based on number of medical enterprises that reported the length of time the technology and not total number of adopters in sample (refer to Table 14 field N**)

Within the patient information storage system category, the data and diffusion curves indicate that electronic record systems for patient demographic data (59.7%) (min=1; max=32; mean=9.464 years) have diffused more than systems for electronic access to imaging tests results and are in the late majority phase of adoption. Systems for electronic access to imaging test results are in the early majority phase of adoption (26.9%) (min=1; max=15; mean=4.958 years)

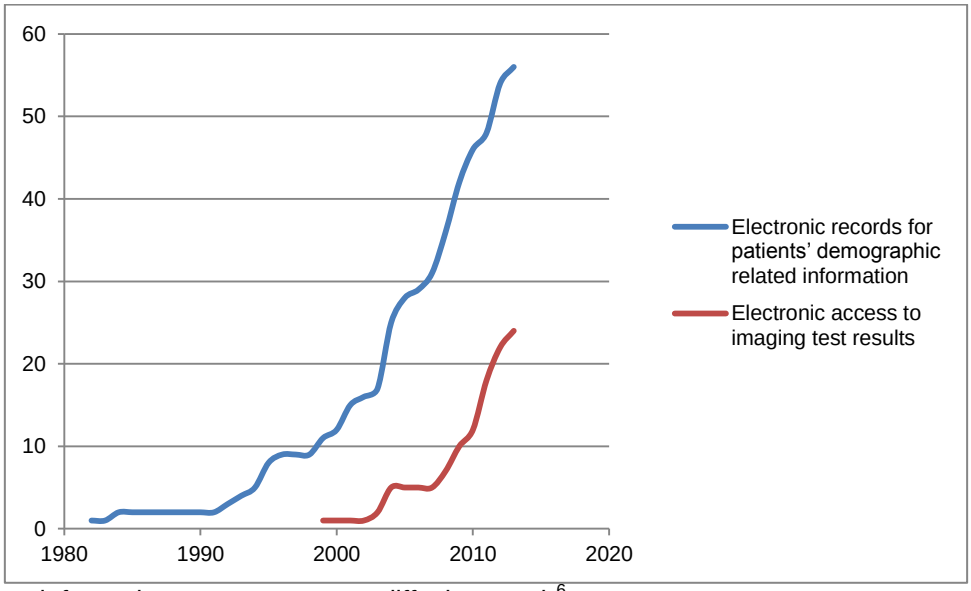


Figure 8: Patient information storage systems diffusion graph[6]

Overall, of the 14 eHealth technologies examined, EFT systems are the most diffused technology (92.3%) with only the laggards left to adopt and ePrescription systems are the least diffused (3.1%) with only a few innovators having adopted. Electronic records for patient financial and fee related information have the longest average time in use (9.648 years), while systems for electronic ordering of laboratory tests have the shortest average time in use (4.333 years). Business productivity and financially orientated applications comprise the top four of the most adopted eHealth systems. Of the applications used for clinical purposes, electronic record systems for patient demographic related information are the most diffused technology (59.7%). Refer to Figure 9 where the all the eHealth technologies were ranked according to their cumulative levels of diffusion into the 130 medical enterprises participating in this study.

[6] Patient Information Storage system diffusion curves based on number of medical enterprises that reported the length of time the technology and not total number of adopters in sample (refer to Table 14 field N**)

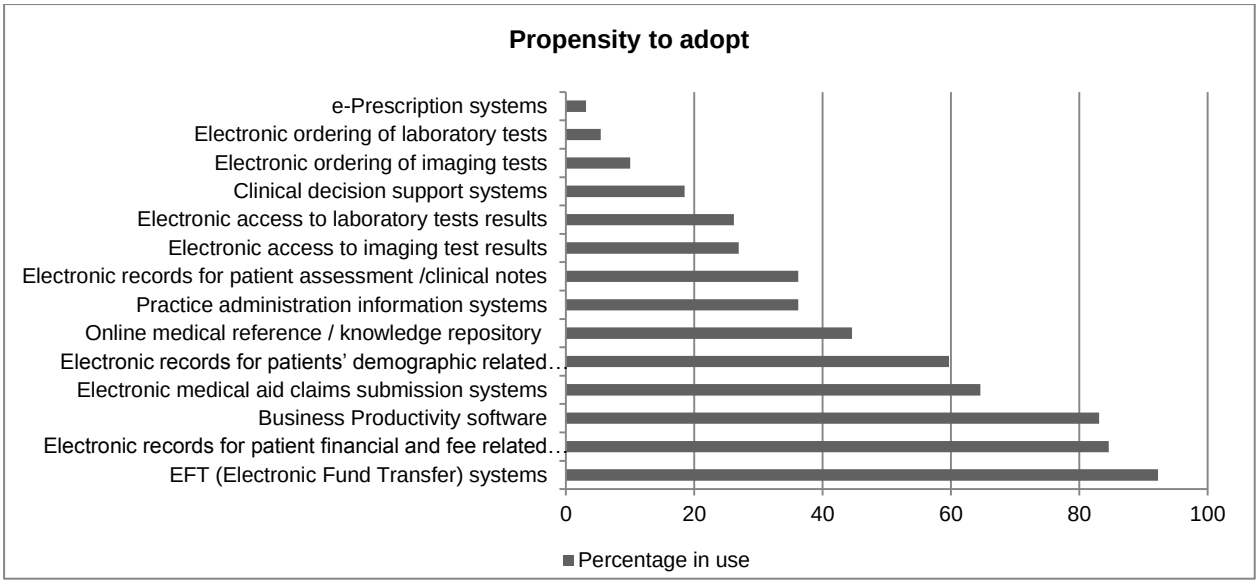


Figure 9: eHealth technologies ranked by adoption status

An overall propensity to adopt score was calculated based on the total number of technology systems in use within the medical enterprise. Refer to Section 3.4.2 which details how propensity to adopt was measured.

The data shows that the propensity to adopt scores ranged from one (only one application in use) to twelve (out of fourteen applications in use). The scores were transformed into categories by normatively splitting the propensity to adopt score. Low adopters were indicated by medical enterprises that had adopted between one and four eHealth systems, medium adopters were indicated by medical enterprises with a score between five and eight and high adopters were medical enterprises that had adopted between nine and twelve eHealth systems. 60.8% of the medical enterprises in the sample were medium adopters and used an average of six eHealth systems.

	Frequency	Percent	Cumulative Percent
Low Adopter	37	28.5	28.5
Medium Adopter	79	60.8	89.2
High Adopter	14	10.8	100
N	130	100	

Table 15: Respondent profile: Propensity to adopt

The next section tests the TOE model as an explanation for this observed variation in the adoption scores.

4.4 FACTORS THAT INFLUENCE PROPENSITY TO ADOPT

Prior to testing the research model of the effects of selected TOE factors on adoption, it was necessary to establish the validity and reliability of the scales used to measure the TOE factors. This is presented next.

4.4.1 VALIDITY AND RELIABILITY

Principal components factor analysis is used in this study to establish construct validity. SPSS (version 21) was used to extract components using the principal component analysis (PCA) method of extraction. PCA allows for an assessment of both convergent and discriminant validity.

Prior to carrying out a factor analysis, a Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett test was examined to verify that the sample size was sufficient to support factor analysis given number of variables. The KMO sampling statistic was 0.802 and was sufficiently large to justify factor analysis. Bartlett's test of Sphericity statistic was significant ($p < 0.001$). As such, using factor analysis was deemed adequate for this study.

A rotated Varimax solution with Kaiser Normalization was obtained. To interpret the factor loadings, recommendations from Hair et al. (2006) were used. They indicated that items are considered practically significant if they load higher than 0.5. A cut-off value of 0.5, which is used to determine whether a given factor loading is salient, was therefore applied in this study. Additionally, items that did not load strongly (i.e. factor loading of less than 0.5) or had high cross-loadings (i.e. load highly on more than one factor) were eliminated (Aladwani & Palvia, 2002; Yang, Cai, Zhou, & Zhou, 2005).

The first iteration of PCA showed that there was a conceptual overlap between the construct "IT skill and know-how" and "Complexity" as items for these constructs loaded onto the same component. The loadings for complexity were higher and as such the items for IT skill and know-how [ITS1, ITS2 & ITS3] were dropped from the analysis, and the construct was dropped from the research model.

Factor analysis showed that items classified as direct and indirect benefits did not load into two components as expected, and/or they cross-loaded or did not converge onto the expected component. This suggests that discriminant validity between the direct and indirect benefits could not be established. Means for benefit items (both direct and indirect) were calculated and the items with means greater than 5 were selected to be included in the factor analysis (refer to Appendix I2 for the questionnaire item means and Figure 10 which illustrates the average rating for each eHealth benefit item). Five items [PDB2, PDB5, PDB7, PIB2 & PIB4] were thus dropped at this stage of the analysis. Any additional items with cross-loadings or loadings less than 0.500 were subsequently deleted from the analysis [PIB3, PDB1 & EP1]. Refer to Table 16 for the results of the final PCA analysis. Seven components, each with an eigenvalue greater than one, were extracted. They mapped onto the variables as illustrated in Table 16. These components explained the majority of the variance (70.531%).

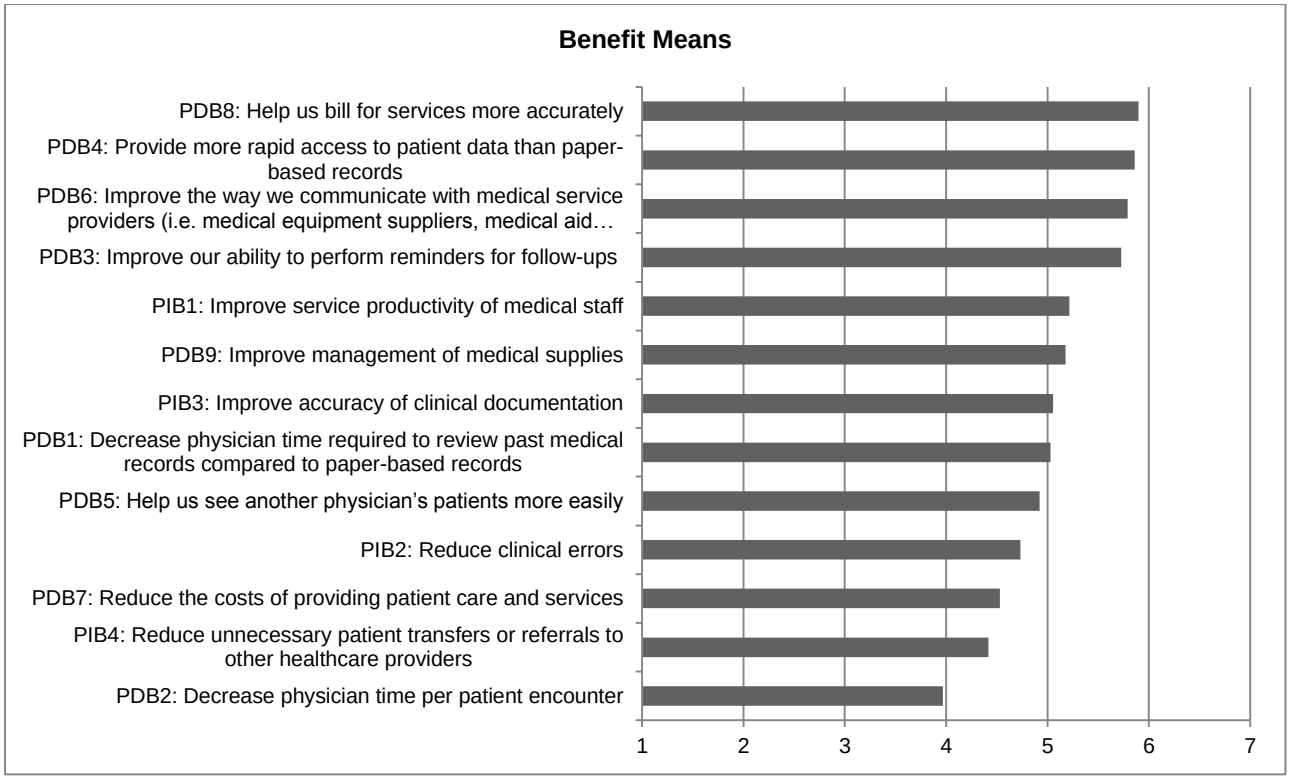


Figure 10: Average ratings: eHealth Benefits

Rotated Component Matrix[a]							
	Component						
	External Pressure	Senior Clinician Involvement	Perceived Benefits	Resource Commitment	Complexity	Regulatory Environment	IT Infrastructure
ITI1							0.675
ITI2							0.741
ITI3							0.664
CM1					0.851		
CM2					0.868		
CM3					0.636		
SCS1		0.849					
SCS2		0.897					
SCS3		0.866					
SCS4		0.795					
RC1				0.765			
RC2				0.822			
RC3				0.742			
EP2	0.765						
EP3	0.652						
EP4	0.723						
EP5	0.801						
EP6	0.788						
EP7	0.747						
RE1						0.929	
RE2						0.937	
RE3						0.601	
PDB8			0.578				
PDB4			0.638				
PDB6			0.584				
PDB3			0.705				
PIB1			0.639				
PDB9			0.625				
Eigenvalue	8.223	3.17	2.091	1.901	1.718	1.378	1.266
% of Variance	29.369	11.323	7.469	6.789	6.136	4.923	4.521
Cumulative %	29.369	40.692	48.161	54.95	61.086	66.009	70.531

PDB=Perceived Direct Benefits; PIB=Perceived Indirect Benefits; ITI=IT Infrastructure; CM=Complexity; SCS=Senior Clinician Involvement; RC=Resource Commitment; EP= External Pressure; RE= Regulatory Environment

a. Absolute values < 0.40 were suppressed.

Table 16: Factor Analysis

The internal consistency (reliability) of the measurement scales was assessed through the Cronbach's alpha (α) coefficient. A scale is deemed reliable and acceptable if the computed Cronbach's alpha value is at 0.70 or higher (Thong, 1999). Item-to-total correlations were also examined and correlation coefficients less than 0.400 indicated measurement error. This meant that the item did not measure the same construct the rest of the items were measuring and should be dropped. No items had an item-to-total correlation less than 0.400 when each

construct was tested for reliability and all items were retained. Table 17 summarizes the results of reliability testing and presents the α values, which are all above 0.70.

	Number of Items	Item Means	α
Perceived Benefits	6	5.612	0.754
IT Infrastructure	3	4.426	0.815
Complexity	3	4.812	0.875
Senior Clinician Involvement	4	4.681	0.934
Resource Commitment	3	4.65	0.839
External Pressure	6	3.984	0.872
Regulatory Environment	3	3.242	0.803

Table 17: Reliability analysis

4.4.2 CONTROL VARIABLES

Age, location and specialization were examined for their effects on adoption scores to determine whether they should be controlled for in subsequent analysis of the research model.

52.3 % of the total sample population had been in operation for less than 10 years and accounted for 60.3% of enterprises that had adopted between five and eight eHealth systems (medium adopters). Table 18 illustrates the total number of adopters per the medical enterprise's number of years in operation.

		OPERATING PERIOD OF MEDICAL ENTERPRISE				
		Younger than 10	11 - 20	21 - 30	Older than 30	Total
ADOPTION CATEGORY	Low Adopter	13	10	9	5	37
	Medium Adopter	47	20	8	3	78
	High Adopter	7	5	1	0	13
Total		67	35	18	8	128

Table 18: Adoption by years in operation

Primary medical enterprises comprised the largest group (43.1 %) of eHealth adopters and of these, more than half (55.4%) were medium adopters. Moreover, two thirds (66.7%) of the total medium adopters were secondary medical enterprises. Table 19 illustrates the total number of adopters per the medical enterprise's speciality.

			SPECIALITY			Total
			Primary	Secondary	Tertiary	
ADOPTION CATEGORY	Low Adopter	**Count**	**17**	**16**	**4**	**37**
		% within ADOPTION CATEGORY	45.9%	43.2%	10.8%	100.0%
		% within SPECIALITY	30.4%	29.6%	20.0%	28.5%
		% of Total	13.1%	12.3%	3.1%	28.5%
	Medium Adopter	**Count**	**31**	**36**	**12**	**79**
		% within ADOPTION CATEGORY	39.2%	45.6%	15.2%	100.0%
		% within SPECIALITY	55.4%	66.7%	60.0%	60.8%
		% of Total	23.8%	27.7%	9.2%	60.8%
	High Adopter	**Count**	**8**	**2**	**4**	**14**
		% within ADOPTION CATEGORY	57.1%	14.3%	28.6%	100.0%
		% within SPECIALITY	14.3%	3.7%	20.0%	10.8%
		% of Total	6.2%	1.5%	3.1%	10.8%
Total		**Count**	**56**	**54**	**20**	**130**
		% within ADOPTION CATEGORY	43.1%	41.5%	15.4%	100.0%
		% within SPECIALITY	100.0%	100.0%	100.0%	100.0%
		% of Total	43.1%	41.5%	15.4%	100.0%

Table 19: Adoption by speciality

One-way between groups ANOVA tests were conducted to compare the effects of the demographic variables: operating period, speciality and location on propensity to adopt. There was a significant difference between the operating bands on propensity to adopt at the $p<0.05$ level ($F=3.477$, $p<0.05$). There was no significant effect of speciality ($F=1.436$, $p>0.05$) and location ($F=0.327$, $p>0.05$). Thus only operating period will be added as a control variable in subsequent tests of the research model.

ANOVA (SPECIALITY)					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.354	2	7.177	1.436	.242
Within Groups	634.539	127	4.996		
Total	648.892	129			

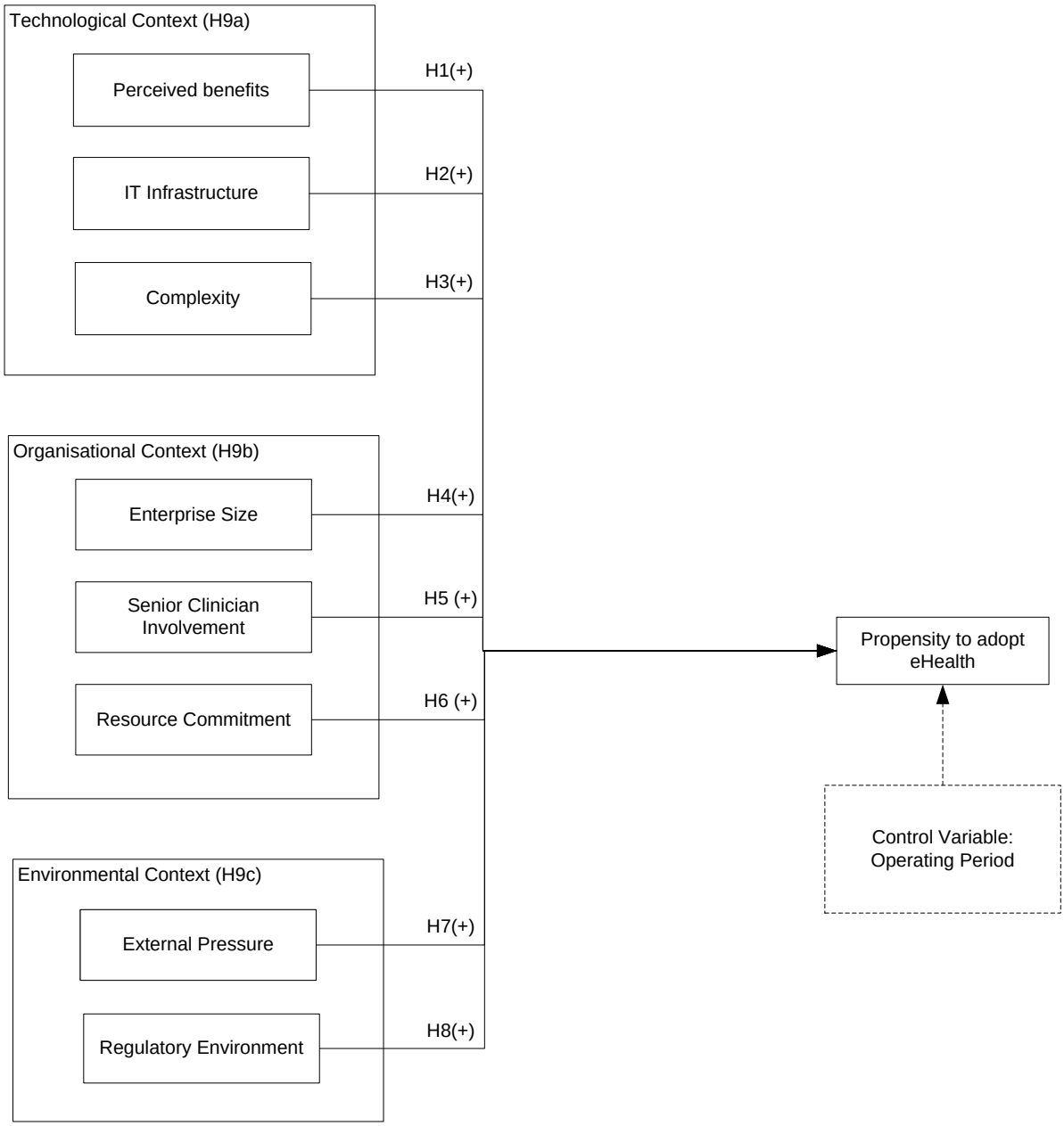
ANOVA (OPERATING PERIOD)					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	49.035	3	16.345	3.477	.018
Within Groups	582.965	124	4.701		
Total	632.000	127			

ANOVA (LOCATION)					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.967	7	1.710	.327	.940
Within Groups	636.925	122	5.221		
Total	648.892	129			

4.5 REVISED MODEL

As noted above, all items of the "IT skill and know how" construct were dropped during factor analysis since it overlapped with the "complexity" construct (i.e. discriminant validity could not be established between the two constructs). The variable was thus dropped from the research model. Given that "IT skill and know how" was dropped, only IT infrastructure will be considered and "Technology Competence" will no longer be examined as a second order construct. The direct and indirect benefits constructs converged into one factor and will be represented by the construct "perceived benefits". Thus hypothesis H2: *The greater the medical enterprises' level of technology competence, the greater will be the propensity to adopt eHealth systems* is dropped from the study, and the resulting revised model is as follows, reflected by the following hypotheses:

H1: The greater the perceived benefits of eHealth systems, the greater will be the propensity to adopt.
H2: The more advanced a medical enterprises' existing IT infrastructure, the greater will be its propensity to adopt eHealth systems.
H3: The higher the perceived complexity of eHealth systems, the lesser will be the propensity to adopt.
H4: The larger the size of a medical enterprise, the greater will be the propensity to adopt eHealth systems.
H5: The higher the level of senior clinician involvement, the greater will be the propensity to adopt eHealth systems.
H6: The greater a medical enterprise's level of resource commitment for eHealth system implementation, the greater will be its propensity to adopt.
H7: The greater the perceived external pressure to use eHealth, the greater will be the propensity to adopt eHealth systems.
H8: The greater the perception of a supportive eHealth regulatory environment, the greater will be the propensity to adopt eHealth systems.
H9a: There is a significant improvement in the explanatory power of the TOE model when technological factors are considered.
H9b: There is a significant improvement in the explanatory power of the TOE model when organisational factors are considered.
H9c: There is a significant improvement in the explanatory power of the TOE model when environmental factors are considered**.**


Technological Context (H9a)
Perceived benefits
IT Infrastructure
Complexity
H1(+)
H2(+)
H3(+)
Organisational Context (H9b)
Enterprise Size
Senior Clinician Involvement
Resource Commitment
H4(+)
H5 (+)
H6 (+)
Environmental Context (H9c)
External Pressure
Regulatory Environment
H7(+)
H8(+)
Propensity to adopt eHealth
Control Variable: Operating Period

4.6 CORRELATION ANALYSIS

Composite scores were computed for the Perceived Benefits, IT Infrastructure, Complexity, Senior Clinician Involvement, Resource Commitment, External Pressure, Regulatory environment and Perceived Benefits variables. The scores were calculated as the average of the items used to measure the variables (surviving the PCA analysis) with each item weighted equally in the calculation. The table below presents the descriptive statistics for each of the composite variables.

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CompositePB	130	2.83	7.00	5.6121	.80970	.656	-.741	.212	1.213	.422
CompositeITI	130	1.00	7.00	4.4259	1.48624	2.209	-.528	.212	-.523	.422
CompositeCM	130	1.00	7.00	4.8117	1.28522	1.652	-.777	.212	.399	.422
CompositeSCS	130	1.00	7.00	4.6807	1.28694	1.656	-.642	.212	.461	.422
CompositeRC	130	1.00	7.00	4.6504	1.30939	1.715	-.608	.212	.002	.422
CompositeEP	130	1.00	7.00	3.9837	1.32334	1.751	-.112	.212	-.745	.422
CompositeRE	130	1.00	6.33	3.2421	1.27762	1.632	.090	.212	-.658	.422

PB=Perceived Benefits; ITI=IT Infrastructure; CM=Complexity; SCS=Senior Clinician Involvement; RC=Resource Commitment; EP= External Pressure; RE= Regulatory Environment

All variables to be included in the model were normally distributed (refer to the table above for skewness and kurtosis measures), except for the Size variable. This variable was normalised by subjecting it to a logarithmic transformation.

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
SIZE	130	1	7	2.28	1.634	2.670	1.782	.212	2.503	.422
TransformSIZE	130	0.00	.85	.2752	.25721	.066	.643	.212	-.318	.422

Since the data is normally distributed and ratio and interval level measures were used, Pearson Product Moment correlation was used to examine the relationships between all independent variables. The sample correlation coefficient (r) indicates the strength of the linear relationship. The direction of the linear relationship is indicated by a positive or negative r value.

	PB	ITI	CM	SIZE	SCS	RC	EP	RE	PTA
PB	1								
ITI	.290**	1							
CM	.351**	.482**	1						
SIZE	-.029	.049	-.133	1					
SCS	.353**	.451**	.512**	.110	1				
RC	.280**	.531**	.446**	.143	.407**	1			
EP	.422**	.327**	.262**	.056	.380**	.213*	1		
RE	.117	.115	-.046	-.044	.074	.068	.248**	1	
PTA	.294**	.480**	.339**	.101	.339**	.337**	.273**	-.082	1

PB=Perceived Benefits; ITI=IT Infrastructure; CM=Complexity; SCS=Senior Clinician Involvement; RC=Resource Commitment; EP= External Pressure; RE= Regulatory Environment , PTA= Propensity to Adopt
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
N= 130

Table 20: Correlation Matrix

Hypothesis 1

The relationship between Perceived Benefits (M=5.6121; SD=0. .80970) and Propensity to Adopt (M=5.91; SD=2.243) was examined. The correlation between these variables yielded a sample correlation coefficient of 0.294 which is statistically significant at the 0.05 level ($r=0.294$, $p<0.01$). This provides support for hypothesis 1 that Perceived Benefits and Propensity to adopt are positively and significantly related. Thus, the greater the perceived benefits of eHealth systems, the greater will be the propensity to adopt.

Hypothesis 2

The relationship between IT Infrastructure (M=4.4259; SD=1.48624) and Propensity to Adopt (M=5.91; SD=2.243) was examined. The correlation between these variables yielded a sample correlation coefficient of 0.480 which is statistically significant at the 0.05 level ($r=0.480$, $p<0.01$). This provides support for hypothesis 2 that IT Infrastructure and Propensity to Adopt are positively and significantly related. Thus, the more advanced a medical enterprises' existing IT Infrastructure, the greater will be its propensity to adopt eHealth systems.

Hypothesis 3

The relationship between Complexity (M=4.8117; SD=1.28522) and Propensity to Adopt (M=5.91; SD=2.243) was examined. The correlation between these variables yielded a sample correlation coefficient of 0.339 which is statistically significant at the 0.05 level ($r=0.339$, $p<0.01$). This provides support for hypothesis 3 that Complexity and Propensity to adopt are positively and significantly related. Since a scale that reflects high scores as low perceived complexity was used, positive correlations imply lesser complexity. Thus, the higher the perceived complexity of eHealth systems, the lesser will be the propensity to adopt.

Hypothesis 4

The relationship between the transformed Size variable (M=0.2752; SD=0.25721) and Propensity to Adopt (M=5.91; SD=2.243) was examined. Size was measured as the total number of employees within the enterprise. The correlation between these variables yielded a sample correlation coefficient of 0.101 which is not statistically significant at the 0.05 level ($r=0.480$, $p>0.05$). A linear association between Size and Propensity to Adopt is not

statistically significantly different from zero. Thus, the size of a medical enterprise cannot be associated with its propensity to adopt eHealth systems.

Hypothesis 5
The relationship between Senior Clinician Involvement (M=4.6807; SD=1.28694) and Propensity to Adopt (M=5.91; SD=2.243) was examined. The correlation between these variables yielded a sample correlation coefficient of 0.339 which is statistically significant at the 0.05 level ($r=0.339$, $p<0.01$). This provides support for hypothesis 5 that Senior Clinician Involvement and Propensity to Adopt are positively and significantly related. Thus, the higher the level of senior clinician involvement, the greater will be the propensity to adopt eHealth systems.

Hypothesis 6
The relationship between Resource Commitment (M=4.6504; SD=1.30939) and Propensity to Adopt (M=5.91; SD=2.243) was examined. The correlation between these variables yielded a sample correlation coefficient of 0.337 which is statistically significant at the 0.05 level ($r=0.337$, $p<0.01$). This provides support for hypothesis 6 that Resource Commitment and Propensity to Adopt are positively and significantly related. Thus, the higher the level of resource commitment for eHealth system implementation involvement, the greater will be the propensity to adopt eHealth systems.

Hypothesis 7
The relationship between External Pressure (M=3.9837; SD=1.32334) and Propensity to Adopt (M=5.91; SD=2.243) was examined. The correlation between these variables yielded a sample correlation coefficient of 0.273 which is statistically significant at the 0.05 level ($r=0.273$, $p<0.01$). This provides support for hypothesis 7 that External Pressure and Propensity to Adopt are positively and significantly related. Thus, the greater the perceived external pressure to use eHealth, the greater will be the propensity to adopt eHealth systems.

Hypothesis 8
The relationship between Regulatory Environment (M=3.2421; SD=1.27762) and Propensity to Adopt (M=5.91; SD=2.243) was examined. The correlation between these variables yielded a sample correlation coefficient of -0.082 which is not statistically significant at the 0.05 level ($r=-0.082$, $p>0.05$). The null hypothesis fails to be rejected and a linear association between Regulatory Environment and Propensity to Adopt cannot be established. Thus, the perception of a supportive eHealth regulatory environment cannot be associated with a medical enterprises' propensity to adopt eHealth systems.

Given the observed correlations between most of the TOE factors and adoption (except size and regulation), analysis could then proceed to examine the relative and combined effects of the factors on adoption through the use of hierarchical multiple regression analysis. Results are presented next.

4.7 MULTIPLE REGRESSION ANALYSIS

Hierarchical regression was used to test the impacts of the TOE factors on Propensity to Adopt. An F test that constituted the test of high level hypotheses that each block of the TOE factors influence propensity to adopt was based on the statistical significance of the change in R^2. Hypotheses 9a, 9b and 9c were tested.

Prior to performing the hierarchical regression, the use of this technique was justified by testing the assumptions of multiple regression. Refer to Appendix L where this was done.

Model 1 considers the effects of the control variable (operating period) on propensity to adopt. This variable was entered as a single block in the first step. The R^2 is 0.079 suggesting that this model explains 7.9% of the variability in Propensity to Adopt.

Model 2 considers the effects of the technological factors on Propensity to Adopt. Propensity to adopt was regressed on the control and the technology variables: Perceived Benefits, IT Infrastructure and Complexity (block 2). The R^2 is 0.321 suggesting that the model explains 32.1% of the variability in Propensity to Adopt. The change in R^2 ($\Delta R^{2)}$ is 0.242. This indicates that the increase in the predictive power of the model is 24.2% given the control variables already in the model. This is significant at the 0.001 level ($\Delta F=14.590$, $p <0.001$).

Model 3 considers the effects of the organisational factors on Propensity to adopt. Propensity to adopt was regressed on the control, the technology and organisation variables: Size, Senior Clinician Involvement and Resource Commitment (block 3). The R^2 is 0.347 suggesting that the model explains 34.7% of the variability in Propensity to adopt. The ΔR^2 is 0.027 and this indicates that the predictive power of the model only increases by 3% when organisational variables are entered. This is not significant at 0.05 level ($\Delta F=1.630$, $p >0.05$).

Model 4 considers the effects of the environmental factors on Propensity to adopt. Propensity to adopt was regressed on the control, technological, organisational and environmental variables: External Pressure and Regulatory Environment. The R^2 is 0.372 suggesting that the model explains 37.2 % of the variability in Propensity to adopt. The ΔR^2 is 0.025 and this indicates that the predictive power of the model only increases by 3% when environmental variables are entered. This is not significant at 0.05 level ($\Delta F=2.346$, $p >0.05$).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.281[a]	.079	.057	2.178	.079	3.598	3	126	.015
2	.566[b]	.321	.288	1.893	.242	14.590	3	123	.000
3	.589[c]	.347	.298	1.879	.027	1.630	3	120	.186
4	.610[d]	.372	.314	1.858	.025	2.346	2	118	.100

a. Predictors: (Constant), isDecade3, isDecade2, isDecade1

b. Predictors: (Constant), isDecade3, isDecade2, isDecade1, CompositeITI, CompositePB, CompositeCM

c. Predictors: (Constant), isDecade3, isDecade2, isDecade1, CompositeITI, CompositePB, CompositeCM, TransformSIZE, CompositeRC, CompositeSCS

d. Predictors: (Constant), isDecade3, isDecade2, isDecade1, CompositeITI, CompositePB, CompositeCM, TransformSIZE, CompositeRC, CompositeSCS, CompositeRE, CompositeEP

Table 21: Results of the Hierarchical Regression Analysis (Model Summary)

Table 22 shows the individual regression coefficients for the models (t-tests were conducted to test the significance of each of the individual coefficients). The t-tests seek to determine whether the beta coefficients for each variable (β) differ significantly from zero. Refer to Appendix M for the detailed results of the t-Tests for individual significance.

In Model 1, isDecade1 and isDecade2 (medical enterprises established in the last 10 and 20 years respectively) have a significant effect on Propensity to Adopt ($p<0.05$). isDecade1 has the largest significant effect on Propensity to Adopt. It has a standardised regression coefficient (β) of 0.491 which is significant at 0.01 level.

In Model 2, IT Infrastructure has the only and largest significant effect on Propensity to Adopt. It has a standardised regression coefficient (β) of 0.419 which is significant at 0.001 level. Thus, IT infrastructure is able to predict Propensity to adopt when the effects of the operating period are controlled for.

In Models 3 and 4, IT Infrastructure and Operating Period had a significant effect on Propensity to adopt when all other factors in the model are considered. Neither Perceived Benefits nor Complexity had a significant effect on Propensity to adopt ($p>0.05$). Moreover, none of the organisational and environmental factors had a significant effect on Propensity to adopt ($p>0.05$). Thus, Size, Senior Clinician Involvement, Resource Commitment, External Pressure and Regulatory environment are not able to predict Propensity to adopt when the effects of the other variables already in the model are included.

	Model 1	Model 2	Model 3	Model 4
IsDecade1	0.491**	0.453**	0.487**	0.487**
IsDecade2	0.448*	0.396*	0.388*	0.398*
IsDecade3	0.163	0.169	0.142	0.144
PB		0.107	0.083	0.055
ITI		0.419***	0.371***	0.367***
CM		0.057	0.031	0.002
SIZE			0.127	0.107
SCS			0.109	0.091
RC			0.023	0.035
EP				0.136
RE				-0.139
R^2	0.079*	0.321 ***	0.347***	0.372***
ΔR^2	0.079*	0.242 ***	0.027	0.025

PB=Perceived Benefits; ITI=IT Infrastructure; CM=Complexity; SCS=Senior Clinician Involvement; RC=Resource Commitment; EP= External Pressure; RE= Regulatory Environment; PTA= Propensity to Adopt
*** $p<0.001$
** $p<0.01$
* $p<0.05$

Table 22: Hierarchical Regression Results (Individual Significance)

As a result of the above analysis, H9a is partially supported with only ITI from the technology category being significant, whilst hypotheses H9b and H9c are rejected.

CHAPTER SUMMARY

This chapter has presented the deductions drawn from the data analysis. It detailed how data was screened for missing values and outliers prior to the analysis. A profile of the sample was then presented. The second research question was addressed by presenting descriptive statistics of medical enterprises which describe the state of eHealth adoption within South African Medical enterprises. The validity and reliability of the measures were then examined and correlation analysis was used to test hypotheses. Results showed that Complexity was negatively related to Propensity to adopt and all other factors in the model, except for Size and Regulatory Environment, are significantly and positively correlated to Propensity to Adopt. Moreover, hierarchical regression was used to test the TOE model. The results of F change tests revealed that organisational and environmental factors do not add predictive power to the model. Additionally, tests of individual significance were done and the results of these tests showed that IT Infrastructure is a key factor in the prediction model for predicting Propensity to Adopt. The next chapter will discuss these findings further and relate the outcomes to existing literature.

5. CHAPTER 5 : DISCUSSION

This chapter discusses the findings for each research question. The first section defines a basic portfolio of eHealth technologies for a South African medical enterprise and discusses the state of eHealth adoption. Next, the effects of the demographic and TOE factors on propensity to adopt are discussed. The findings are related back to the TOE studies found in the literature to determine whether the findings confirm or deviate from expectation. Explanations of the observed findings are given.

5.1 EHEALTH PORTFOLIO

This study's first research question (RQ1) was: What constitutes the basic portfolio of eHealth technologies for a South African medical enterprise? This research question was addressed by performing a literature and eHealth vendor website review to identify technologies used by South African medical enterprises. Health information technology lists from studies by Davis et al (2009) and Manochehri et al. (2012), and product lists of prominent software vendors (i.e. iSoft, Mediswitch, etc.) provided important inputs and were consolidated with the preliminary list from the review. It was found that 14 technologies could comprise a basket of eHealth technologies. These technologies were classified into categories defined by Pagliari et al. (2005). Hikmet, et al.'s (2008) categorisation of eHealth technologies into different functional areas was initially relied upon for classification into the different functional areas. It was found that South African medical enterprises use technologies to support three main functional areas: the healthcare business management, professional clinical informatics and patient information storage functional areas. The study did not focus on consumer health informatics systems as none of the technologies identified could be classified within this category. Future research may wish to consider a basket of consumer health informatics applications.

The list of technologies which could comprise an eHealth portfolio is as follows:

a. Electronic records for patients' demographic related information
b. Electronic records for patient assessment /clinical notes
c. Electronic records for patient financial and fee related information
d. Electronic ordering of laboratory tests
e. Electronic ordering of imaging tests (i.e. X-rays, CT scans, MRI scans, etc.)
f. Electronic access to laboratory tests results
g. Electronic access to imaging test results (i.e. X-rays, CT scans, MRI scans, etc.)
h. Electronic medical aid claims submission systems
i. EFT (Electronic Fund Transfer) systems
j. Practice administration information systems (booking / patient scheduling systems)
k. ePrescription systems
l. Business productivity software (i.e. Microsoft Word or Excel)
m. Clinical Decision Support systems to support diagnostic decisions or patient care plans
n. Online medical reference / knowledge repository (for drugs, clinical guidelines) (i.e. Medline)

Having identified the above mentioned eHealth portfolio, the second research question aimed to determine their state of adoption. The next section discusses the state of adoption of eHealth within South African medical enterprises.

5.2 STATE OF ADOPTION

This study's second research question (RQ2) was: What is the current state of adoption of these eHealth technologies by medical enterprises in South Africa? This research question was addressed by asking the responding medical enterprises to indicate, from a predefined eHealth portfolio (defined by RQ1), the technologies they had implemented within the enterprise. This information was used to compute a propensity to adopt score which indicated the total number of systems in use. Additionally, the respondents were asked to indicate the length of time that they had each system in place.

This study found that the average medical enterprise uses an average of six application systems. Given the definition used in this study that an enterprise is a medium technology adopter if it has implemented between five and eight eHealth technologies, South African medical enterprise are on average medium technology adopters (based on this study's defined eHealth basket). Although previous literature (Lustria, et al., 2011; Neuhauser & Kreps, 2003) denotes that general eHealth adoption remains low, this study indicates that adoption rates are improving and medical enterprises are improving their usage of technology systems.

Furthermore, the state of diffusion of each technology was established by plotting diffusion curves, which were then compared to Rogers' (2010) generic diffusion s-curve. The technologies were classified as either in the innovation, early adoption, early majority, late majority or laggard phases of adoption. It was found that EFT systems and Electronic records for patient financial and fee related information systems are in the laggard phase of adoption[7] while Business productivity software, Electronic medical aid claims submission systems and Electronic records for patients' demographic related information are in the late majority phase of adoption. Therefore, the study shows that medical enterprises are more inclined to adopt financially oriented business management systems to help operate their enterprises more effectively (Refer to Section 4.3 Figure 9 which illustrates that financially oriented applications comprise the top four of the most adopted eHealth systems).

This finding was expected as it suggests that medical enterprises operate as independent business entities, and prioritise their profitability goals. The use of information systems is therefore strategic, to help achieve business-related goals. It was also expected that the adoption of clinical information systems would be prioritised to help improve the quality of healthcare service delivery. Despite medical enterprises' predisposition towards business management systems, a steady but continued increase[8] in the adoption of clinical information systems was noted, indicating that medical enterprises realise the importance of clinical information systems and will implement systems that will help meet their patients' clinical needs.

Additionally, the study found that ePrescription, Electronic ordering of laboratory tests and Electronic ordering of imaging tests are in the early phases of adoption and are the least diffused systems within the eHealth portfolio. The maximum time in use of these technologies (ePrescription=16years [9], Electronic ordering of laboratory tests=10years Electronic ordering of imaging tests=18years) implies that these technologies have been

[7] Only laggards have not yet adopted the use of this technology
[8] This increase was indicated by the cumulative number of users over time
[9] ePrescription maximum reported by optometrist and refers to optical prescription system

available on the market for quite some time already, but have not diffused rapidly. This could imply that medical enterprises may currently not perceive these systems as value adding systems and may underrate their benefits. Alternatively, this could imply that medical enterprises face barriers that prohibit the adoption of these technologies. This suggests that inhibitors to adoption need to be identified to allow interventions to be taken to improve future adoption.

The need to identify enablers and inhibitors underpinned the third research question of this study which focused on TOE factors that explained the current state of adoption. This involved developing a model where eight hypotheses were proposed. The initial model sought to determine whether the variables: Perceived Benefits (a composite of direct and indirect benefits), Technology competence (a composite of IT infrastructure and IT skills and know-how), Complexity, Size, Senior Clinician Involvement, Resource Commitment, External Pressure and Regulatory Environment significantly influenced Propensity to adopt. IT skills and know-how was later dropped and consequently, Technology Competence. The model was then revised and the final revised model sought to determine whether Perceived Benefits, IT infrastructure, Complexity, Size, Senior Clinician Involvement, Resource Commitment, External Pressure and Regulatory Environment influenced Propensity to adopt while controlling for demographic factors. The next section discusses the effects of demographic factors on propensity to adopt.

5.3 EFFECTS OF DEMOGRAPHIC FACTORS ON PROPENSITY TO ADOPT

This study examined the effects of organisation age (operating period), location and specialisation to determine if they should be controlled for in the analysis of the research model.

Organisation age (operating period) was found to have a significant impact on adoption. This suggests that younger medical enterprises are more inclined to implement eHealth systems. Younger medical enterprises may find it easier to adopt new technologies as opposed to their older counterparts, given that the implementation of new eHealth systems may require older enterprises to change their organisation processes, changes that they are most likely to resist (Sahadev & Islam, 2005).

The study also proposed to control for specialisation, with the premise being that specialist medical enterprises have a higher propensity to adopt than generalist medical enterprises, given that medical organisations that provide more specialised services will have a need for ICT systems to co-ordinate and manage complex internal processes. The results showed that this was not supported and a medical enterprises' speciality did not influence likelihood to adopt. Previous studies have shown that the scope of activities that enterprises are engaged in influence its propensity to adopt ICTs (Sahadev & Islam, 2005; Zhu, et al., 2003). This finding is interesting as it indicates that medical enterprises across all speciality categories (i.e. primary, secondary and tertiary medical enterprises) are using eHealth. It is indicative that eHealth adoption is not limited to specialist practices, but is something all medical enterprises are engaging. This finding is also plausible in this study given that the adoption of a basket of generic applications (applications applicable to all types of medical enterprises) was studied.

Finally, the study proposed to control for location. Medical enterprises in more developed regions (i.e. Gauteng and Western Cape regions) were deemed more likely to have been higher technology adopters. Given that these regions are suburban and urban regions, medical enterprises established in these regions are likely to have access to the financial and technological resources required to adopt eHealth. Location was, however, not found to influence propensity to adopt. This may have been due to the under-representation of practices based in non-urban regions. However, it is also likely that the private South African medical enterprises that were surveyed are self-reliant and have the ability to source financial and technological resources, and are not reliant on provincially funded initiatives.

Although the study had proposed to control for demographic variables as predictors of Propensity to Adopt, the main aim of the study was to improve our understanding of the TOE factors that influence adoption. This study's third research question (RQ3) was: What are the technological, organisational and environmental factors influencing the propensity of South African medical enterprises to adopt eHealth technologies? The next sections discuss the effects of these factors on adoption and address RQ3.

5.4 EFFECTS OF TECHNOLOGICAL FACTORS ON PROPENSITY TO ADOPT

5.4.1 PERCEIVED BENEFITS

This study proposed that medical enterprises who perceive eHealth as beneficial had a greater propensity to adopt eHealth systems. The study focused on direct and indirect benefits. Direct benefits included eHealth's ability to 1) decrease physician time required to review past medical records compared to paper-based records 2) decrease physician time per patient encounter 3) improve the enterprise's ability to perform reminders for follow-ups 4) provide more rapid access to patient data than paper-based records 5) help the physicians within the enterprise see another physician's patients more easily 6) improve the way the enterprise communicates with medical service providers (i.e. medical equipment suppliers, medical aid companies or labs) 7) reduce the costs of providing patient care and services 8) help the enterprise to bill for services more accurately and 9) improve management of medical supplies. Indirect benefits included eHealth's ability to 1) improve service productivity of medical staff 2) reduce clinical errors 3) improve accuracy of clinical documentation and 4) reduce unnecessary patient transfers or referrals to other healthcare providers. These direct and indirect benefits converged into one factor which comprised six of the highest rated benefits.

This proposition was supported and is consistent with findings from previous studies (Hung, et al., 2010; Iacovou, et al., 1995; Kuan & Chau, 2001; Lee & Shim, 2007; Scupola, 2009; Thong, 1999; Wang & Ahmed, 2009) who found perceived benefits to be a predictor of Propensity to Adopt. The benefits of eHealth help in the development a robust business case for IT investment. The study showed that the highest rated benefits included: effective billing for services, improved communication with service providers, improved ability to perform reminders for check-ups and improved management of medical supplies, quicker access to patient data and improved service productivity of medical staff. These benefits are examples of operational-, service- and efficiency- related benefits that can be realised when eHealth systems are implemented within medical enterprises. These benefits may result in reduced operational costs. This then creates an awareness of the financial benefits derived from the use of eHealth, which in turn provides support for business case for eHealth investments.

These benefits also suggest that benefits realised from using eHealth are not only limited to the medical enterprise but to external stakeholders such as its patients. Given the positive benefits highlighted above it is not surprising that this study found it to positively influence eHealth adopt.

Moreover, amongst the possible eHealth benefits presented, the study rated these benefits: helping clinicians see another clinician's patients more easily, reducing clinical errors, reducing the costs of providing patient care and services, reducing unnecessary patient transfers or referrals to other healthcare providers and decreasing clinician time per patient encounter, as the lowest rated benefits. It is surprising that eHealth is not perceived to reduce clinical errors as previous studies (Bradley, Pratt, Thrasher, Byrd, & Thomas, 2012; Wu, Wang, & Lin, 2007) have shown how the use of health information systems mitigates clinical errors. It was also unanticipated that eHealth was found not to reduce service costs for the patient, as noted in previous studies (Hu, et al., 2002; McCullough, Casey, Moscovice, & Prasad, 2010). This is particularly interesting as it means that the reduced operational costs and savings incurred by the medical enterprise may not ultimately result in lowered service costs for the patient. It was, however, not surprising that eHealth was not considered to be helpful for performing functions such as facilitating the transfer and referral process and the viewing of other clinician's patients. As shown in Section 5.6.2, the use of eHealth is not stringently regulated. As a result, the systems used by South African medical enterprises are not standardised and inter-organisational systems may not be interoperable. The non-standardisation of eHealth may thus explain why these inter-organisational eHealth benefits may have not been realised.

5.4.2 IT INFRASRUCTURE

The study had initially proposed to study the effects of technology competence on propensity to adopt. Technology competence had two dimensions: IT infrastructure and IT skill and know how (Zhu, et al., 2003). These dimensions could not be established as the study's technological context also included the effects of complexity on propensity to adopt. The "IT skills and know-how" and "Complexity" variables could not be discriminated. This could suggest that the extent to which a system is perceived as complex depends on the user's skill. Possibly, the high skill levels amongst clinicians and practice managers may minimise the extent to which they perceive eHealth complexity, because they have the cognitive ability to grasp new concepts. Alternatively, the lack of IT skills and know how may precede perceived complexity. This contributes to literature as it shows that the dimensions of technology competence cannot be established in the presence of a variable measuring complexity and the relationship between these variables needs further examination. As such, IT skills and know how was dropped and only the effects of IT infrastructure were tested.

It was then hypothesized that the more advanced a medical enterprises 'existing IT infrastructure, the greater will be its propensity to adopt eHealth systems. This hypothesis was supported and IT infrastructure sophistication was found to have a positive effect on propensity to adopt. Most importantly, data analysis revealed that IT infrastructure is the only factor that had a significant effect on Propensity to adopt when all the other independent variables in the TOE model were held constant (Refer to Section 4.7 Table 22). This finding is explained by the notion that application performance in enhanced when there is good underlying hardware and network infrastructure (Foster, Geisler, Nickless, Smith, & Tuecke, 1996). eHealth applications work seamlessly and more efficiently if they are deployed on

stable, interconnected infrastructure (Bharadwaj, 2000); IT infrastructure is therefore a possible precedent to the efficiency related benefits of eHealth. The finding that IT infrastructure explained the largest amount of variance in adoption suggests that SA medical enterprises may currently lack the overall infrastructure necessary for them to take greater advantage of eHealth and to continue their investments into the technologies.

Moreover, this finding is consistent with findings in previous studies (Kuan & Chau, 2001; Pan & Jang, 2008) which attested to the importance of technology resources for information systems adoption. In their study, Zhu et al. (2003) found that IT infrastructure provides a platform on which e-business can be built. Similarly, this study shows that the high diffusion of technology devices (computers and mobile devices) and underlying communications technologies such as the internet or wireless technology precedes eHealth system adoption.

5.4.3 COMPLEXITY

This study hypothesized that medical enterprises that had high perceptions of the complexity of eHealth systems had a lower propensity to adopt eHealth systems. This hypothesis stems from the idea that adoption barriers stem from the difficulty in learning to use the eHealth systems. This hypothesis was supported and is consistent with findings from previous studies (Grandon & Pearson, 2004; Gu, et al., 2012; Thong, 1999). eHealth systems are meant to simplify clinical process and the perception that learning to use the systems requires intense training deters clinical staff from using the technology. Moreover, the perceived complexity of eHealth system may increase the risk of administrative and clinical errors, thereby further deterring medical enterprises from implementing eHealth.

The study shows that the perception of low complexity of technology systems encourages clinicians and practice staff to use implemented eHealth systems. Specifically, results showed that adoption rates increased when the systems are easy to use, when the effort required to learn to operate eHealth systems was minimal and when clinical staff find it easy to become skilful in using eHealth. Thus, this study shows that technology adoption is influenced by the simplicity in the design of an eHealth system.

5.5 EFFECTS OF ORGANISATIONAL FACTORS PROPENSITY TO ADOPT

5.5.1 SIZE

It was hypothesized that larger medical enterprises have a higher propensity to adopt eHealth systems. Previous studies (Gu, et al., 2012; Pan & Jang, 2008; Thong, 1999; Zhu, et al., 2002) found that size significantly influenced propensity to adopt information technology. The supposition was that larger organisations have the resources to facilitate innovation adoption (Bose & Luo, 2011; Glynn, et al., 2005). This proposition was not supported. Results showed that organisation size was not related to the degree of technology adoption. This finding shows that a medical enterprise's propensity to adopt eHealth systems is not influenced by the number of employees within the medical enterprise.

The study shows that smaller medical organisations with fewer employees are as likely to adopt technology as their larger counterparts. Although they operate as independent smaller enterprises and adoption decisions are made independently as standalone practices, they may be affiliated to a hospital system or a larger network. Through this system they may have access to the skills and infrastructure required to operate eHealth systems (Hikmet, et al.,

2008). This organisation structure (i.e. affiliation) thus facilitates the adoption and use of innovations. Future research may wish to examine the effects of affiliation on adoption. On the other hand, larger centralised enterprises may have adopted less technology because the complex structure of firms may deter the implementation of new systems, thus making them less flexible to changes, a phenomenon known as structural inertia (Tan, et al., 2007; Zhu, et al., 2004). Thus, the structure of the medical enterprise may offset enterprise size as a predictor of propensity to adopt and may explain why enterprise size was not found to be a significant factor that influences propensity to adopt.

5.5.2 SENIOR CLINICIAN INVOLVEMENT

A finding that supported the hypothesis that senior clinician involvement is a significant organisational factor that influenced propensity to adopt was made. This finding shows that technology systems implemented within medical practices are driven by the medical enterprises' practitioners' needs and their attitudes toward technology. As shown in previous studies (Grandon & Pearson, 2004; Gu, et al., 2012; Scupola, 2009), when practitioners advocate the use of technology, more technology systems will be implemented and used.

This finding was expected given that clinicians in single practitioner and smaller practices are responsible for eHealth adoption decisions. When clinicians realise the benefits of eHealth, they are likely to allocate the resources required to implement the systems and subsequently encourage other members of staff to use it. This finding is plausible for medical enterprises where clinicians are responsible for eHealth acquisition. It can be argued that the finding may not be universally applicable, especially within enterprises where clinicians do not make eHealth adoption decisions. In larger enterprises, clinicians may have favourable attitudes towards innovative technology systems and may want to use them, but these systems may not be implemented and management may not be keen on investing in technology. This argument can be offset if clinicians ardently champion technology use, make a good case for eHealth system use and thus influence management to implement the systems. Thus, as shown in this study, clinicians play an important role in promoting the use of eHealth in South African medical enterprises.

5.5.3 RESOURCE COMMITMENT

This study hypothesized that medical enterprises with greater levels of resource commitment will have a greater propensity to adopt eHealth study. This hypothesis was supported. A previous study (Bose & Luo, 2011) showed that the assignment of financial resources is an antecedent to technology adoption. When medical enterprises are willing to allocate financial resources to pay for installation costs, the implementation of subsequent enhancements and ongoing charges during usage, the extent to which technology is adopted becomes much higher (Iacovou, et al., 1995). Firms with a higher budget are better positioned to adopt eHealth (Hong & Zhu, 2006). This study's finding is consistent with the results of these studies.

Furthermore, the study highlighted the importance of technical and managerial resources as adoption determinants. As in prior studies (Kuan & Chau, 2001; Lee & Shim, 2007) this study showed that the extent to which an enterprise dedicates IT assets and human resources to manage health systems is related to the levels of technology adoption. A plausible explanation for this finding is that medical enterprises often assign practice managers or administrators as eHealth system proprietors, whose responsibility is to manage the IT systems in the enterprise. Failure to assign these resources may result in ineffectively

managed systems which may create perception that eHealth systems are burdensome, further leading to non-adoption. Thus, this study showed that although the allocation of financial resources for new systems is important, value from eHealth systems can be derived when an enterprise has the capability to effectively assign technical and managerial resources.

5.6 EFFECTS OF ENVIRONMENTAL FACTORS ON PROPENSITY TO ADOPT

5.6.1 EXTERNAL PRESSURE

This study hypothesized that medical enterprises that had a greater perception of external pressure to use eHealth had a greater propensity to adopt eHealth. The results of the study showed that this proposition was supported. South African medical enterprises operate within healthcare delivery networks and are likely to be influenced by external entities (i.e. patients, medical aid companies, equipment suppliers, competitors, etc.). This finding corroborates the finding in previous studies (Wang & Ahmed, 2009; Zhu, et al., 2002, 2003) where external pressure was found to be an adoption driver.

Medical enterprises interact with medical equipment suppliers, medical aid companies, laboratories and competitors, using information technology systems as a communication medium. The finding suggests that medical enterprises adopt technology systems so that they can be integrated into healthcare networks and to improve the way they collaborate with other stakeholders in these networks. Moreover, medical enterprises implement technology to provide a better administrative or clinical service for their patients, thereby improving their competitive position. This means that South African medical enterprises adopt technologies not only to enhance their image as technology leaders, but also their image as good service providers, given that high quality of care is associated with new technology.

Contrary to this finding, some studies showed that enterprises are exempt from vendor pressures (Lee & Shim, 2007) while others showed that competitive pressures do not have a significant effect on the decision to adopt, particularly in developing countries (Kuan & Chau, 2001; Thong, 1999; Zhu & Kraemer, 2005). The studies, however, explained that technology competence amongst enterprises was not a priority as there weren't many enterprises using technology. Since then, more medical enterprises have been established resulting in greater variety and availability of healthcare delivery options and thus, there has been an increase in competitive pressures. Technology adoption may be required to help keep enterprises ahead of their competition and is thus becoming a competitive necessity for private medical enterprises. Thus, this study has shown that this increased external pressure has resulted in an increased propensity to adopt.

5.6.2 REGULATORY ENVIRONMENT

This study proposed that medical enterprises that had a greater perception of a supportive eHealth regulatory environment had a greater propensity to adopt eHealth. The results of the study showed that this proposition was not supported. This finding corroborates the finding by Scupola (2009) and Tan et al. (2007) who showed that regulatory support is context specific and regulatory bodies may not always impact a medical enterprise's adoption decision. This finding is plausible given the differing laws and governing bodies in each country.

This finding is contrary to the findings by Zhu et al. (2004) and Kuan and Chau (2001) who showed that regulation plays a significant role in the adoption of technology in developed countries. These studies showed that government interventions, through the provision of incentives, make healthcare innovations more affordable, which enhances medical enterprises' inclination to adopt. The lack of government funded eHealth initiatives in South Africa may be a reason the results do not show a significant relationship between the regulatory and environment support. Additionally, medical enterprises may only adopt a technology only if there is a legal requirement for them to do so (i.e. a medical enterprise may only adopt a billing system when pricing regulations are enforced). Given that there are currently few laws that guide eHealth use, their proposed positive influence on adoption may not have been noted in this study.

In addition to the relationship between regulation environment and propensity to adopt not being significant, it was also found to be very weak and negative. This suggests that there is a possibility that medical enterprises may view the current regulatory environment as an adoption inhibitor. South African regulatory bodies may have inadvertently put restrictions in place that prevent enterprises from using technology. Practical evidence of this was noted when a South African health professions council dismissed a telemedicine initiative (Davids, 2013), but statistical evidence to prove this is yet to be obtained. Existing policies and laws (e.g. Health Professions Act, 56 of 1974) defined by regulatory bodies may be bureaucratic and these may be reviewed to identify how they impede technology adoption. These impediments can then be addressed.

Furthermore, the results of the study indicate that the environmental context of eHealth adoption is mainly a function of market forces (i.e. external pressures) as opposed to a function of regulatory pressure. This implies that government interventions to promote eHealth use may not be as effective as external environmental pressures. This further indicates that government currently has no leverage, and has minimal influence on the private sectors' technology adoption decisions; while external pressures remain the main drivers of adoption. As such, government's role in eHealth adoption for private South African medical enterprises is restricted to the implementation of eHealth governance structures, which involves framing legislation and monitoring conformance. Although government seeks to spearhead eHealth initiatives, their efforts could be more effective in a secondary, supportive role. Government's role remains a supportive role and can help ensure that all eHealth initiatives in both the public and private sectors remain co-ordinated.

5.7 OVERALL TECHNOLOGY, ORGANISATION AND ENVIRONMENT MODEL

Although correlational relationships were established between adoption and some of the organisational (Senior Clinician Involvement and Resource Commitment) and environmental factors (External Pressure), hierarchical regression analysis showed that organisational and environmental factors do not significantly improve the explanatory power of a model that predicts Propensity to Adopt. Moreover, IT infrastructure, a technological factor, and operating period, a demographic factor, were the only factors that significantly predicted Propensity to adopt when all the other variables in the model were accounted for. Interestingly, this implies that organisational and environmental factors do not significantly add to the prediction of medical enterprises' current propensity to adopt. The results, however, showed that although the current state of adoption is mainly influenced by

technological factors, organisational and environmental factor are likely to become important when technological foundations have been established.

CHAPTER SUMMARY

This chapter presented a summary of the state of the adoption of eHealth systems by the responding private medical enterprises in SA. The chapter first presented a list of eHealth technologies that a typical modern medical enterprise should have. The chapter then presented and discussed the state of adoption and showed that South African medical enterprises are medium technology adopters and use, on average, six application systems. It was then showed that health information systems in the private sector are mostly financially oriented, business management systems. Electronic Fund Transfer systems are the most diffused systems while ePrescription systems are the least diffused. Furthermore, our knowledge of the factors that influence technology adoption within South African medical enterprises was extended by discussing the effects of demographic and TOE factors on propensity to adopt. In particular, IT infrastructure was highlighted as the most important technological factor for adoption. Additionally, organisational factors such as senior clinician involvement and resource commitment were shown to have a positive effect on propensity to adopt. Moreover, in eHealth's environmental context, the variability in propensity to adopt was explained by external pressures as opposed to a supportive regulatory environment. The next chapter discusses the implications of these findings and concludes the study.

6. CHAPTER 6: CONCLUSION

This chapter provides a summary of the research findings to ensure that all research questions were addressed and to verify that the research objectives were met. This is then followed by the implications of the findings for practice and academia. The study's limitations are outlined and avenues for future research are suggested. Finally, closing remarks are given to conclude the study.

6.1 SUMMARY OF FINDINGS

The first aim of the study was to draw on available literature to identify a portfolio of technologies that constitute eHealth. The study found 14 technologies that could comprise a basket of eHealth technologies for use in the South African context. A literature and eHealth vendor website review revealed that: Electronic records for patients' demographic related information, Electronic records for patient assessment/clinical notes, Electronic records for patient financial and fee related information, Electronic Ordering of tests and access to test results, Electronic ordering of laboratory tests, Electronic ordering of imaging tests. Electronic access to laboratory tests results, Electronic access to imaging test results, Electronic medical aid claims submission systems, EFT systems, Practice administration information systems, ePrescription systems, Business productivity software, Clinical Decision Support systems and Online medical reference systems comprise a list of eHealth technologies used in South African medical enterprises.

A survey was then carried out in order to examine the current state of adoption of these technologies as well as the factors influencing adoption. Data was collected from 130 medical enterprises across South Africa. Responding medical enterprises represented a range of healthcare services from primary through to tertiary level, and both small and large practices were sufficiently represented.

With respect to the current state of eHealth adoption, results showed that EFT Systems are the most diffused systems while ePrescription systems are the least diffused. Results also showed that eHealth systems classified under the business management healthcare functional area are the most diffused systems as these systems comprised the top four of the most adopted systems. Clinical information systems showed a steady increase in adoption rates.

The third aim of the study was to identify the factors impacting the adoption of eHealth. Results from the survey confirmed that all factors in the TOE model, except size and regulatory environment are correlated with Propensity to Adopt. The study showed that perceived benefits, IT infrastructure, senior clinician involvement, resource commitment and external pressure are positively related to the propensity to adopt while complexity was negatively associated. It was also shown that the enterprise's age and IT infrastructure are key factors that influence Propensity to adopt when all factors in the TOE model are considered.

6.2 IMPLICATIONS FOR PRACTICE

The results of this study can be used as a benchmark which allows medical enterprises to evaluate and compare their technology adoption status to the average South African medical enterprise. It informs medical enterprise management on where their organisation stands as

compared to the average South African medical enterprise (i.e. whether they are lagging behind, are on par or are innovators). This will inform their IT procurement decisions, as to whether they need to acquire eHealth systems as strategic systems to keep abreast with their peers and competitors.

Furthermore, the results of this study inform medical enterprises that the quality of IT infrastructure significantly improves the chances for successful implementation and use of eHealth systems. Although it can be perceived that managing network infrastructure for connectivity is not a medical enterprises' core competence, sustaining and investing in IT infrastructure remains an important factor for adoption of value adding eHealth systems. This function can be outsourced to network service providers if necessary, but will have financial implications for the enterprise. Thus, if an enterprise's key objective is to become leaders in the use of eHealth, they need to manage their IT resources adequately in order to realise its benefits.

The results of this study inform various stakeholders of the contributions they can make to create a favourable eHealth environment. Regulatory bodies can use this information and reflect on their eHealth policies as the study showed that the current regulatory environment may not be conducive for technology adoption. Health industry decision makers can be informed that market forces are strong and the adoption of eHealth is becoming competitive necessity. Clinicians may take an active role in advocating eHealth use as their influence was shown to be important. This can be done by communicating the importance of eHealth, making an effort to convince other staff members of the benefits of eHealth or by encouraging them to use new technology systems. Patients may request their healthcare providers to use eHealth as part of their service package; and can then validate that healthcare services become more convenient and accessible when technology is engaged.

Furthermore, the results of this study propose possible new strategies for eHealth system vendors. eHealth software vendors may commission market research to find out what makes their systems complex to use and provide the necessary eHealth systems training. Vendors can modify their marketing strategies to target recently established medical enterprises to improve sales as newly established medical enterprises were found to be more likely to invest in eHealth technologies. Vendors can also develop less network resource intensive applications given the infrastructure (i.e. network and hardware) limitations within medical enterprises. Alternatively, cloud computing has created opportunities for new health-IT business models and medical enterprises may examine if it is a viable solution for overcoming infrastructure barriers. The study by Kuo (2011) proposed a healthcare cloud computing strategic planning model and this model can be used to help medical enterprises transition from vendor managed systems to cloud based healthcare systems.

6.3 IMPLICATIONS FOR ACADEMIA

A socio-technical approach to understanding technology adoption was adopted in this study by using the TOE framework as a theoretical underpinning. Various factors were identified from a literature review to ensure that the selected TOE factors would contribute to the model's explanatory power. The technological factors emerged as most important in this study as results showed that the propensity to adopt eHealth is largely a function of the availability of IT infrastructure resources. The results implied that a technology focused model currently explains the propensity to adopt eHealth, as non-technical factors do not

significantly improve explanatory power. Although this is contrary to the findings in a previous study (Tsiknakis & Kouroubali, 2009) who showed that a socio-technical approach is best for predicting adoption, it confirms implications by other previous studies (Viitanen, et al., 2011). Correlation results, however, suggest that clinician involvement and resource commitment are important organisational factors to be examined in future studies. Organisational factors may have greater explanatory power once initial infrastructural barriers have been resolved. Future research should also consider the role of market forces in driving adoption relative to government incentives.

A combination of more than one theoretical model may also be required to improve our understanding of adoption of complex new technologies such as eHealth (Oliveira & Martins, 2011). Future eHealth researchers may therefore consider employing diffusion of innovation theory (Rogers, 2010), the DeLone McLean model (DeLone & McLean, 2003), institutional theory, and/or the FITT framework as potential theoretical underpinnings to help improve our understanding of eHealth adoption at the organisational level (Oliveira and Martins, 2011).

6.4 LIMITATIONS

This study has a number of limitations that should be recognized. First, a literature review was conducted to address the first research question and Information Systems articles were preferred if they were published in Information Systems journals ranked highly by Peffers and Ya (2003). Peffers and Ya (2003)'s journal ranking article was published over a decade ago. This implies that the selected articles may have been published in journals that are not currently highly ranked. Although other mitigating selection criterion were applied (i.e. relevance based on title and abstract review and high citation indices), a current ranking (if one were available) of IS journals may have led to the inclusion of additional articles in the literature review.

The basket of technologies was identified via a literature review and review of the websites of vendors of health information systems in South Africa. Whilst this helps to ensure the selection of technologies that are available for adoption and therefore have relevance to practitioners in the field, the comprehensiveness of the list cannot be assured and other eHealth technologies may have been omitted. Future research may wish to extend the portfolio of technologies.

Second, a non-probabilistic sampling method was used to select respondents who received hand-delivered questionnaires. This sampling method may limit the generalisability of the findings. Third, the web based survey may have excluded non-internet populations, which further limits generalisability of the findings. Fourth, the data was self-reported and is subject to respondent biases. Additionally, it cannot be assured that the online respondent identified themselves honestly as an IT manager, practice administrator or clinician who is responsible for procuring eHealth applications. Moreover, the survey had a low response rate of 13.87% and thus a potential non-response bias which may lower the external validity of the findings.

Fifth, this study has adopted a cross-sectional and relational research design. Therefore, causal relationships cannot be inferred. Future research can consider a longitudinal design to improve understanding of how eHealth technologies continue to be adopted and how they diffuse over time.

Sixth, the study focused on the adoption of fourteen pre-defined technologies. The results may not be generalisable to another portfolio of eHealth technologies. Moreover, the factors that influence adoption may not be generalisable to the adoption of each individual technology within the portfolio. Thus, the results may not accurately reflect the propensity to adopt individual technologies within the portfolio i.e. an organisation may have a low propensity to adopt the entire portfolio of technologies, but a high propensity to adopt one of the technologies within the portfolio.

Lastly, most of the responding medical enterprises were located in the Gauteng area (65%). Although this region hosts the largest population of any of the country's nine provinces, it has the smallest regional area. The lack of dispersion of the responses may limit the generalisability of the findings to the less represented geographic areas. Moreover, the Gauteng region is an urban area and the over-representation of Gauteng based medical enterprises in the sample may not reflect the adoption behaviour of non-urban or rural medical enterprises.

6.5 FUTURE RESEARCH

The TOE framework does not provide a concrete model describing the factors that influence organisational adoption decisions, thus improvements to the model can be made. This can be done by adding and testing different TOE factors. This study's model explained a total of 37.2% of the variability in propensity to adopt. The model does not explain the majority of the variability in propensity to adopt. Weak and moderate relationships were established between most of the variables and variables that have stronger relationships with Propensity to adopt can be identified and tested. Additional variables are required to improve the accuracy of predictions of Propensity to adopt eHealth and this study's model can be used as a foundation to build upon. Alternatively, as aforementioned, future research may employ other theories to help improve our understanding of eHealth adoption at the organisation level.

Over a third (36.2 %) of the responding medical enterprises were single practitioner practices. Therefore, future studies may wish to examine adoption from other theoretical lenses such as the use of the Technology Acceptance Model to understand adoption as an individual level behaviour within single physician practices. The study can also be replicated in other contexts (different geographic regions), with larger samples.

This study focused on eHealth adoption. Future research may wish to focus on outcomes or impacts of adoption. For example, a study could be carried out to determine whether meaningful use of adopted eHealth technologies can result in patient benefits and improved quality of health care services.

Finally, this study focused on generic eHealth applications. The study focused on the adoption of multiple technologies across multiple enterprises with varying specialities. Respondents were required to identify technologies used within their practices that were not considered in this study. Speciality specific applications (e.g. custom developed applications, dedicated hearing aid software used by audiologists, etc.) were amongst the eHealth systems that were found to have been excluded. Thus, future research can study the adoption of speciality-specific technologies and more focused studies (i.e. one technology per speciality)

can be conducted. This study did not examine consumer health informatics applications. These systems are implemented by healthcare providers for use by consumers. Future studies may wish to focus on the use of these technologies by consumers and the motivation of healthcare providers to engage with health consumers through such technologies.

6.6 CONCLUSION

This study has contributed to existing eHealth literature by identifying a portfolio of eHealth technologies and examining their state of adoption within medical enterprises in South Africa. Diffusion curves for each of the technologies were analysed and as a result medical enterprises are now in a position to evaluate and make informed decisions regarding their adoption of eHealth.

By using the TOE framework, the study further contributed to the general eHealth literature by addressing a research gap that indicated that the framework had not been using to study eHealth adoption in the South African context. Through the use of quantitative empirical methods, it was shown that although technological factors (especially IT infrastructure) emerged as the most important factors for adoption, organisational and environmental factors are also important to adoption. Specifically, the study showed that perceived benefits, IT infrastructure, senior clinician involvement, resource commitment and external pressure are positively linked with the propensity to adopt while perceived technology complexity prohibited adoption. Through the implementation of enabling infrastructure and with the participation of involved stakeholders, eHealth adoption can be improved and thus create an environment which will allow for the realisation of the benefits of eHealth use.

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APPENDIX A: EHEALTH TECHNOLOGY IDENTIFICATION

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
Cross-Layer Ultrasound Video Streaming Over Mobile WiMAX and HSUPA Networks (Alinejad, Philip, & Istepanian, 2012)	Information Technology in Biomedicine, IEEE Transactions on		✓															
An empowerment-based approach to developing innovative e-health tools for self-management (Alpay, van der Boog, & Dumaij, 2011)	Health Informatics Journal	✓	✓															
Toward a Consumer-to-Healthcare provider (C2H) electronic marketplace(Altinkemer, et al., 2006)	Communications of the Association for Information Systems						✓			✓	✓	✓						
Trends and challenges of the emerging technologies toward interoperability and standardization in e-health communications(Aragues et al., 2011)	Communications Magazine, IEEE		✓		✓													
Time to rethink health care and ICT?(Avison & Young, 2007)	Communications of the ACM					✓	✓	✓		✓			✓	✓				
E-health: transforming the physician/patient relationship(Ball & Lillis, 2001)	International Journal of Medical Informatics						✓	✓		✓			✓		✓	✓		
Physicians and ambulatory electronic health records (Bates, 2005)	Health Affairs					✓												

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
Comparing approaches for advanced e-health security infrastructures (Blobel, 2007)	International Journal of Medical Informatics					✓												
Evaluation of Websites that Provide Information on Alzheimer's Disease(Bouchier & Bath, 2003)	Health Informatics Journal						✓											
Health Websites In US Propose New Ethics Code (Charatan, 2000)	BMJ: British Medical Journal						✓											
Does the implementation of an electronic prescribing system create unintended medication errors? A study of the sociotechnical context through the analysis of reported medication incidents (Redwood, Rajakumar, Hodson, & Coleman, 2011)	BMC Medical Informatics and Decision Making									✓								
Integration of a nationally procured electronic health record system into user work practices (Cresswell, 2012)	BMC Medical Informatics and Decision Making					✓												
Determining the privacy policy deficiencies of health ICT applications through semi-formal modeling (Croll, 2011)	International Journal of Medical Informatics			✓		✓				✓								
Investigating risk exposure in e-health systems (Croll & Croll, 2007)	International Journal of Medical Informatics					✓										✓		

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
Integration of the HL7 Standard in a Multiagent System to Support Personalized Access to e-Health Services (De Meo, Quattrone, & Ursino, 2011)	IEEE Transactions on Knowledge and Data Engineering								✓									
Medicine 2.0: Social Networking, Collaboration, Participation, Apo mediation, and Openness (Eysenbach, 2008)	Journal of medical Internet research					✓			✓									
CONSORT-EHEALTH: Improving and Standardizing Evaluation Reports of Web-based and Mobile Health Interventions (Eysenbach, 2011)	Journal of medical Internet research		✓				✓											
Expectations and experiences of eHealth in primary care: A qualitative practice-based investigation (Flynn, Gregory, Makki, & Gabbay, 2009)	International Journal of Medical Informatics					✓	✓	✓		✓			✓					
Across the Atlantic cooperation to address international challenges in eHealth and health IT: Managing toward a common goal (Friedman, Iakovidis, Debenedetti, & Lorenzi, 2009)	International Journal of Medical Informatics					✓												

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
An agenda for action on global e-health (Gerber, Olazabal, Brown, & Pablos-Mendez, 2010)	Health Affairs		✓	✓		✓	✓											
The business of eHealth (Gorm, 2002)	International Journal of Medical Marketing		✓	✓		✓	✓											
Primary Medical Care Outside Normal Working Hours: Review Of Published Work(Hallam, 1994)	BMJ: British Medical Journal										✓							
Factors that influence public engagement with eHealth: A literature review (Hardiker, 2011)	International Journal of Medical Informatics			✓			✓				✓							
Guest Editorial Introduction to the Special Section on M-Health: Beyond Seamless Mobility and Global Wireless Health-Care Connectivity (Istepanian, Jovanov, & Zhang, 2004)	Information Technology in Biomedicine, IEEE Transactions on		✓															
Securing the communication of medical information using local biometric authentication and commercial wireless links (Ivanov, Yu, & Baras, 2010)	Health Informatics Journal		✓															

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
Costs and difficulties of recruiting patients to provide e-health support: pilot study in one primary care trust (Jones, O'Connor, Brelsford, Parsons, & Skirton, 2012)	BMC Medical Informatics and Decision Making					✓	✓	✓									✓	
Scope of policy issues in eHealth: results from a structured literature review (Khoja, Durrani, Nayani, & Fahim, 2012)	Journal of medical Internet research					✓					✓							
Secure e-Health: Managing risks to patient health data (Kluge, 2007)	International Journal of Medical Informatics					✓												
Personal health records (Lafky & Horan, 2011)	Health Informatics Journal					✓												
Towards a continuous evolution and adaptation of information systems in healthcare (Lenz & Kuhn, 2004)	International Journal of Medical Informatics																	✓
Matrix analysis of the digital divide in eHealth services using awareness, want, and adoption gap (Liang, 2012)	Journal of medical Internet research		✓		✓		✓											
Decision support for healthcare in a new information age (Liu Sheng, 2000)	Decision Support Systems													✓			✓	
Trust-building measures: a review of consumer health portals (Luo & Najdawi, 2004)	Communications of the ACM						✓											

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
Partitioning knowledge bases between advanced notification and clinical decision support systems (Lussier et al., 2007)	Decision Support Systems		✓														✓	
Exploring digital divides: An examination of eHealth technology use in health information seeking, communication and personal health information management in the USA (Lustria, et al., 2011)	Health Informatics Journal					✓	✓				✓							
Global e-health policy: A work in progress (Mars & Scott, 2010)	Health Affairs			✓														
E-health progresses in Romania (Moisil & Jitaru, 2006)	International Journal of Medical Informatics			✓			✓				✓			✓			✓	
Smart Cards: The Key to Trustworthy Health Information Systems (Neame, 1997)	BMJ: British Medical Journal					✓												
IEEE 802.16/WiMAX-based broadband wireless access and its application for telemedicine/e-health services (Niyato, Hossain, & Diamond, 2007)	Wireless Communications, IEEE		✓		✓													

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
Potential of electronic personal health records (Pagliari, Don, & Singleton, 2007)	BMJ: British Medical Journal					✓												
Guest Editorial Introduction to the Special Issue on Citizen Centered e-Health Systems in a Global Healthcare Environment: Selected Papers From ITAB 2009 (Pattichis et al., 2011)	IEEE Transactions on Information Technology in Biomedicine			✓		✓			✓					✓			✓	
Designing and implementing telemonitoring for early detection of deterioration in chronic disease: Defining the requirements (Peirce, Hardisty, Preece, & Elwyn, 2010a)	Health Informatics Journal			✓														
Evaluation and implementation of e-health and health information initiatives: International perspectives (Peirce, Hardisty, Preece, & Elwyn, 2010b)	Health Informatics Journal				✓	✓												
Telemedicine and E-Health (Pinciroli et al., 2011)	Pulse, IEEE		✓	✓	✓	✓												

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
A patient centred framework for improving LTC quality of life through Web 2.0 technology (Pulman, 2010)	Health Informatics Journal								✓									
Building consensus about eHealth in Slovene primary health care: Delphi study (Rade, Matic, & Igor, 2011)	BMC Medical Informatics and Decision Making						✓											
Strategic marketing in the eHealth era: Who will own the provider's networked desktop? (Raymond, 2002)	International Journal of Medical Marketing						✓			✓								
e-Records in health - Preserving our future (Scott, 2007)	International Journal of Medical Informatics	✓				✓												
Access and authorisation in a Glocal e-Health Policy context (Scott, Jennett, & Yeo, 2004)	International Journal of Medical Informatics					✓												
From Molecule to Man: Decision Support in Individualized E-Health (Sloot, Tirado-Ramos, Altintas, Bubak, & Boucher, 2006)	Computer													✓			✓	
Developing an online learning community for mental health professionals and service users: a discursive analysis (Smithson, Jones, & Ashurst, 2012)	BMC Medical Education					✓	✓	✓			✓							

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
On the staffing policy and technology investment in a specialty hospital offering telemedicine (Tarakci, Ozdemir, & Sharafali, 2009)	Decision Support Systems			✓			✓								✓			
Understanding Clinical Work Practices for Cross-boundary Decision Support in e-Health(Tawfik, et al., 2012)	Information Technology in Biomedicine, IEEE Transactions on	✓															✓	
Adoption and use of social media among public health (Thackeray, Neiger, Smith, & Van Wagenen, 2012)	BMC Public Health								✓									
Enabling secure service discovery in mobile healthcare enterprise networks (Toninelli, Montanari, & Corradi, 2009)	Wireless Communications, IEEE		✓	✓	✓													
Identifying RFID-embedded objects in pervasive healthcare applications (Tu, et al., 2009)	Decision Support Systems	✓			✓												✓	
The Development of Data Infrastructures for eHealth: A Socio-Technical Perspective (Ure, et al., 2009)	Journal of the Association for Information Systems					✓								✓				

Title	Journal	custom healthcare information systems	mHealth	Telemedicine (tracking devices, using telecommunication for tele-monitoring)	wireless	Electronic Health Records (local/web based)	Internet /websites	email	Social media	e-prescription	online consultations	e-payments	e-booking / appointment schedulers	image archiving	referral systems	test results notification systems	online medical databases / decision support systems	ERP
Organizational effects of information and communication technology (ICT) in elderly homecare: a case study(Vimarlund, Olve, Scandurra, & Koch, 2008)	Health Informatics Journal		✓	✓														
A Web 2.0 Model for Patient-Centered Health Informatics Applications (Weitzel, Smith, de Deugd, & Yates, 2010)	Computer								✓									
Asynchronous health care communication (Wilson, 2003)	Communications of the ACM			✓			✓	✓			✓							
Towards consistent modes of e-health implementation: structurational analysis of a telecare programme's limited success(Boonstra & Van Offenbeek, 2010)	Information Systems Journal			✓														
Social, ethical and legal barriers to E-health(Anderson, 2007)		✓				✓												
e-Health technologies show promise in developing countries (Blaya, 2010)	Health Affairs		✓	✓		✓							✓			✓	✓	
Tracing and cataloguing knowledge in an e-health cardiology environment (Gortzis & Nikiforidis, 2008)	Journal of Biomedical Informatics																✓	
Total		**4**	**15**	**15**	**7**	**27**	**20**	**6**	**6**	**7**	**8**	**1**	**4**	**6**	**2**	**3**	**10**	**1**

APPENDIX B: Literature Review – Organisational Studies

Study	Theoretical Underpinning	Context	Research Method	Contributions	Shortcomings	Key Findings
(Viitanen, et al., 2011)	DeLone and McLean and Activity Theory	Finland	Survey	A heterogeneous target group of physicians (with varying specialities) was targeted to help researchers understand end-users' experiences on the usability of numerous ICT systems in clinical settings.	The research instrument was not subjected to reliability testing (methodological).	System quality (system failures or lack of integration between systems) was found to be negatively associated with usability.
(Ayal & Seidman, 2009)	Atheoretical	US	Survey	The study extended the literature on information economics by quantifying the benefits of eHealth processes.	Data was sampled from a single hospital and the results may be difficult to generalise.	This study showed that ICT adoption is an antecedent to improved performance levels.
(Burkhard, et al., 2010)	Atheoretical	US	Survey	The study explored the adoption of impacts of employer provided health records. It explored the chosen technology factors in the employment context (corporate environment as opposed to clinical environment).	The selected sample was not representative of the population.	Perceived privacy and security of personal health data in technology was found to influence the confidence in use of the technology.
(Simon, et al., 2007)	Atheoretical	US	Survey	The study identified and investigated the impacts of organisational factors on adoption of EHRs.	The study only considered the organisational factors that influence adoption of EHRs.	Size was positively correlated with EHR adoption. Organisational factors such as start-up and on-going financial costs and loss of productivity were found to influence adoption decisions.
(Simon, et al., 2009)	Atheoretical	US	Survey	The study is a longitudinal study that sought to determine whether technology usage gaps narrowed over time.	The study is not based on theory.	The study reported that physicians' reported adoption rates of EHRs increased over time.
(Tsiknakis & Kouroubali, 2009)	FITT	Greece	Secondary Data analysis and case study	The "Fit between Individuals, Task and Technology" (FITT) framework was used to analyse the socio-organizational-technical factors that influence eHealth adoption. A mixed method research methodology was also used.	The quantitative research methods were used as a supplement to the mainly qualitative research approach. Results may be difficult to generalise.	Individual abilities (user), technology characteristics and task requirements were found to impact technology adoption.
(Raghupathi & Wu, 2011)	Original Framework	US	Secondary data analysis, interviews, field observations and content analysis	The study investigated the adoption of technology at macro-level. The study's context is the public health context.	The study is a cross sectional study. A longitudinal study can be conducted to test the potential for causal relationships.	The study confirmed the association relationship between ICTs and public health delivery.

Study	Theoretical Underpinning	Context	Research Method	Contributions	Shortcomings	Key Findings
(Paré, et al., 2011)	Readiness Model	Canada	Survey	The study studied technology acceptance at both organisational level but did not dissociate associated with organisational e-readiness from individual clinicians' perceptions. The study identified and included change management related factors that are associated with organisational readiness.	Analysis was based on a single type of technology and limits generalisability of findings to other eHealth technologies.	The factors: change appropriateness, organizational flexibility, vision clarity, and change efficacy were found to be positively related to organisational readiness.
(Chatterje e, et al., 2009)	DeLone and McLean	US and Canada	Quantitative content analysis	The study draws on the DeLone and McLean Model of IS success presents a theoretical framework to better understand and clarify the success factors associated with mobile healthcare work.	The study is a cross section study and does not assess causal relationships.	The effects of data processing, information access and communicability on mobile health use were not supported. The effects of portability and system reliability were supported.

APPENDIX C: Literature Review – Individual Studies

Study	Theoretical Underpinning	Context	Research Method	Contributions	Shortcomings	Key Findings
(Andreassen, et al., 2007)	Atheoretical	Europe	Telephone Survey	The study is a comparative study and focused on the eHealth adoption behaviours of physicians across seven countries.	The study only considered how demographic factors influence adoption of eHealth. The study is not based on theory.	Factors that positively affected the use of the Internet for health purposes were youth, higher education, white-collar or no paid job, visits to the GP during the past year, long-term illness or disabilities, and a subjective assessment of one's own health as good.
(Gulmans, Vollenbroek-Hutten, van Gemert-Pijnen , & van Harten, 2011)	Atheoretical	Netherlands	Experiment	The study aimed to evaluate whether professionals' use and non-use of a web-based communication system was associated with their expectancies and background.	The study only considered technological and demographic factors to investigate the use of web based communications technologies.	The variable 'system use' was found to be associated with expected ease of use and the practice's patient base.
(Neter, 2012)	Atheoretical	Israel	Survey	The study focused on the impacts of knowledge related concepts such as digital access, and digital literacy on Internet use.	The study is a cross sectional study. A longitudinal study can be conducted to test the potential for causal relationships. The study is not based on theory.	Digital access, literacy and other demographic variables have impact on the positive outcomes on internet use.
(Ortega Egea, et al., 2010)	Atheoretical	Europe	Survey	The study provided a description of the adoption of various eHealth services and applications.	The study only considered how demographic factors influence adoption of eHealth. The study is not based on theory.	Physician age and practice size influenced the adoption of eHealth. Gender and practice location did not influence the adoption of eHealth.
(Chikotie, et al., 2011)	Drew on DOI / TAM / FITT	South Africa	Surveys and Interviews	The study identified factors that influence eHealth adoption from a developing country context.	The study did not specify the analytical techniques used to derive data. The validity of the results cannot be assured.	The study identified that external factors such as ethics and regulations play a role in the use of ICTs in healthcare service delivery.
(Kelley, et al., 2011)	Precede-Proceed health promotion model (PPM)	UK	Field Experiment	The study used health promotion theory to analyse a model on the adoption of eHealth.	Used single item measures to measure some of their constructs. Measurements can be expanded upon to provide accurate results.	Defined predisposing, reinforcing and enabling factors influence individual and population adoption behaviours.

Study	Theoretical Underpinning	Context	Research Method	Contributions	Shortcomings	Key Findings
(Chang & Chang, 2008)	Service Encounters Evaluation Model	Taiwan	Survey	The study applied a marketing model, the Service Encounters Evaluation Model to evaluate the adoption of electronic health records and appointment booking systems.	The study is cross sectional. It also acknowledges the lack of generalisability of the findings to the adoption of other eHealth technologies.	Technology-based service encounters were found to have a positive impact on service quality, but not patient satisfaction.
(Crutzen, et al., 2011)	TAM	Netherlands	Field Experiment & Survey	The study used a different design method (field experiment) to investigate the impacts of eHealth interventions.	The study is a cross section study and longitudinal studies are needed to investigate whether people will actually revisit intervention websites and whether this leads to changes in health risk behaviours.	The findings demonstrate that the user perceptions regarding and enjoyment both had a positive effect on e-loyalty. User perceptions and e-loyalty had no significant impact on the usage of the interventions.
(Dünnebeil, et al., 2012)	TAM	Germany	Survey	The study is a confirmatory study as it is an extension of previous studies that use TAM to understand technology acceptance in healthcare.	The study did not consider variables from other models such as the Extended Technology Acceptance Model (TAM2) or theory of planned behaviour.	Technological factors, such as information security, process orientation and e-health-related knowledge were identified as additional drivers for the acceptance of eHealth.
(Ortega Egea & Román González, 2011)	TAM	Spain	Survey	The Technology Acceptance Model (TAM) is extended with trust and risk-related factors such as physicians' perceptions of institutional trust, perceived risk, and information integrity.	The study investigated the adoption behaviour of one technology. It is difficult to generalise the results to technologies other than EHCRs.	The results show that attitudinal factors (attitude towards usage and perceived institutional trust) and cognitive instrumental processes (mainly, usefulness perceptions) determine physicians' intention to use EHCR systems.
(Tung, et al., 2008)	DOI & TAM	Taiwan	Survey	The study combines innovation diffusion theory, technology acceptance model and added two research parameters, trust and perceived financial cost to propose a new hybrid technology acceptance model.	Statistical results showed that additional variables are required to improve the accuracy of predictions of usage intentions.	The study shows that 'compatibility', 'perceived usefulness', 'perceived ease of use', and 'trust' all have great positive influence on 'behavioural intention to use'. The study showed that 'perceived financial cost' has great negative influence on behavioural intention to use.
(del Hoyo-Barbolla, et al., 2006)	TAM & Health Belief Model	Spain	Survey	The study proposed a general framework for the evaluation of attitudes towards eHealth applications. It also defines the different stages the user is at in	The framework has not been validated and was being tested in clinical trials. There is no empirical evidence that illustrates the degree to which	Proposed that eHealth utilisation is impacted by both health behaviour and technological (knowledge, motivation and access) aspects.

Study	Theoretical Underpinning	Context	Research Method	Contributions	Shortcomings	Key Findings
				terms of their perceptions of their use of technology.	health behaviour and technological aspects impact the use of technology.	
(Vance Wilson & Lankton, 2004)	TAM, motivational model, integrated model	US	Survey	The study applied three theoretical models of IT acceptance to test the acceptance of eHealth. It also tested the impacts of antecedent factors on the TAM (PU and PEOU) and Motivational model (extrinsic and intrinsic motivation).	The study is restricted to one geographic location. The study is a cross section study of technology acceptance, research into continuance (whether or why patients use applications over time) might provide insights into the process of improving eHealth.	Antecedent factors of satisfaction with provider, information-seeking preference, and Internet dependence predicted constructs in the models.
(Tawfik, et al., 2012)	Theory of Planned Behaviour Situated Action Theory	UK, the UAE and Nigeria	Survey	The study identified the differences in in clinical practices across regional boundaries and therefore identifies the needs of both developed and developing countries that influence the type of technology systems being used. Acknowledged that these needs impact the practices decision patterns and therefore design and implementation of decision support systems.	The study only investigated the organisational and social cultural factors that influence the decision to used clinical decision support systems. Since this is a cross-national study, exploring the impact of environmental factors the decision to adopt DSS might be valuable.	The study found a significant relationship between 'Local work context factors', 'Tendency to adhere to clinical practice guidelines' and 'Tendency to offer patient-centred care' on Perceived differences in local practice and decision making patterns'.
(Hsu et al., 2005)	Atheoretical	US	Secondary data analysis	The study is a longitudinal study. It investigated the impacts of Socio-demographic and clinical characteristics on patterns of eHealth use.	The study is not based on theory.	The use of eHealth services has increased over time. There is a significant and growing digital divide with respect to e-Health services across racial/ethnic groups.
(Hu, Wei, & Liu Sheng, 2006)	Atheoretical	Taiwan	Field Experiment & Survey	The study uses the controlled experiment methodology (as opposed to survey research) to assess the effects of a healthcare information system on clinical services.	The study is not based on theory. The sampling methodology may limit generalisability of the findings.	The use of technology improves clinical efficacy, increases efficiency and improves satisfaction.

APPENDIX D: Technological Context Variables

	Technology	Sensory Readiness (Virtualisation)	Relationship Readiness	Synchronism Readiness(Ease of Integration)	Identification and Control Readiness	Perceived Benefits	Technology Competence			Compatibility/Technology Integration	Reliability	Perceived Ease of Use / Complexity	Perceived Usefulness	Security Concern
							IT infrastructure (technology readiness)	IT Knowledge (Skills)	IT know-how					
Integrative framework for assessing firms' potential to undertake Green IT initiatives via virtualization – A theoretical perspective (Bose & Luo, 2011)	Green IT	✓	✓	✓	✓									
Commercial adoption of open source software: an empirical study(Glynn, et al., 2005)	Open Source Software					✓	Dissatisfaction with existing proprietary systems	Appropriately skilled IT personnel		Ability to run older hardware	Coherent Stable existing IT infrastructure			
Electronic commerce adoption: an empirical study of small and medium US businesses (Grandon & Pearson, 2004)	e-Commerce											✓	✓	
Unified Modeling Language (UML) IT adoption — A holistic model of organizational capabilities perspective (Gu, et al., 2012)	UML					✓	Satisfaction with existing SAD	✓				Complexity		

	Technology	Sensory Readiness (Virtualisation)	Relationship Readiness	Synchronism Readiness(Ease of Integration)	Identification and Control Readiness	Perceived Benefits	Technology Competence			Compatibility/Technology Integration	Reliability	Perceived Ease of Use / Complexity	Perceived Usefulness	Security Concern
							IT infrastructure (technology readiness)	IT Knowledge (Skills)	IT know-how					
Two-Sided Adoption of Mobile Marketing Platforms: Towards an Integrated Conceptual Model (Guo, Zhao, Jin, & Zhang, 2010)	Mobile Marketing					Relative Advantage		✓		✓				✓
Migrating to internet-based e-commerce: Factors affecting e-commerce adoption and migration at the firm level(Hong & Zhu, 2006)	e-Commerce									Integration				✓
Determinants of the adoption of enterprise resource planning within the Technology-Organisation-Environment framework: Taiwan's communications industry(Pan & Jang, 2008)	ERP Systems						✓							
SMEs'e-commerce adoption: perspectives from Denmark and Australia (Scupola, 2009)	e-Commerce					✓		✓						
Business-to-business adoption of eCommerce in China (Tan, et al., 2007)	B2B													
The moderating effect of the business strategic orientation on eCommerce adoption: Evidence from UK family run SMEs (Wang & Ahmed, 2009)	e-Commerce					✓								

	Technology	Sensory Readiness (Virtualisation)	Relationship Readiness	Synchronism Readiness(Ease of Integration)	Identification and Control Readiness	Perceived Benefits	Technology Competence			Compatibility/Technology Integration	Reliability	Perceived Ease of Use / Complexity	Perceived Usefulness	Security Concern
							IT infrastructure (technology readiness)	IT Knowledge (Skills)	IT know-how					
Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors (Zhu, et al., 2003)	e-Business						✓	Technology Competence	✓					
Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry (Zhu, et al., 2004)	e-Business						Technology Readiness							
A cross-country study of electronic business adoption using the technology-organization-environment framework(Zhu, et al., 2002)	e-Business						✓	✓	✓					
What leads to post-implementation success of ERP? An empirical study of the Chinese retail industry(Zhu, et al., 2010)	ERP Systems									Implementation Quality				
A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework(Kuan & Chau, 2001)	EDI					✓		Technology Competence						
An exploratory study of radio frequency identification (RFID) adoption in the healthcare	RFID					✓		✓						

	Technology	Sensory Readiness (Virtualisation)	Relationship Readiness	Synchronism Readiness(Ease of Integration)	Identification and Control Readiness	Perceived Benefits	Technology Competence			Compatibility/Technology Integration	Reliability	Perceived Ease of Use / Complexity	Perceived Usefulness	Security Concern
							IT infrastructure (technology readiness)	IT Knowledge (Skills)	IT know-how					
industry(Lee & Shim, 2007)														
An integrated model of information systems adoption in small businesses(Thong, 1999)						Relative Advantage		✓		✓		Complexity		
Total		**1**	**1**	**1**	**1**	**8**	**6**	**9**	**2**	**5**	**1**	**3**	**1**	**2**

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APPENDIX E: Organisational Context Variables

	Champion Support	Resource Commitment /Constraints	Firm Size	Firm Scope	Top Management Support	Organisational Readiness	Organisation Culture	Perceived barriers
Integrative framework for assessing firms' potential to undertake Green IT initiatives via virtualization – A theoretical perspective (Bose & Luo, 2011)	✓	✓	✓					
Commercial adoption of open source software: an empirical study(Glynn, et al., 2005)		Limited financial Resources	✓		✓			
Electronic commerce adoption: an empirical study of small and medium US businesses (Grandon & Pearson, 2004)					✓	Financial and technological resources, compatibility		
Unified Modeling Language (UML) IT adoption — A holistic model of organizational capabilities perspective (Gu, et al., 2012)			✓		✓		✓	
Two-Sided Adoption of Mobile Marketing Platforms: Towards an Integrated Conceptual Model (Guo, et al., 2010)			✓					
Migrating to internet-based e-commerce: Factors affecting e-commerce adoption and migration at the firm level(Hong & Zhu, 2006)		Spending						✓
Determinants of the adoption of enterprise resource planning within the Technology-Organisation-Environment framework: Taiwan's communications industry(Pan & Jang, 2008)			✓					✓
SMEs'e-commerce adoption: perspectives from Denmark and Australia (Scupola, 2009)					✓			
Business-to-business adoption of eCommerce in China (Tan, et al., 2007)								

	Champion Support	Resource Commitment /Constraints	Firm Size	Firm Scope	Top Management Support	Organisational Readiness	Organisation Culture	Perceived barriers
The moderating effect of the business strategic orientation on eCommerce adoption: Evidence from UK family run SMEs (Wang & Ahmed, 2009)						✓		
Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors (Zhu, et al., 2003)			✓	✓				
Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry (Zhu, et al., 2004)		✓	✓	✓				
A cross-country study of electronic business adoption using the technology-organization-environment framework(Zhu, et al., 2002)			✓	✓				
What leads to post-implementation success of ERP? An empirical study of the Chinese retail industry (Zhu, et al., 2010)					Leadership involvement	✓		
A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework(Kuan & Chau, 2001)		✓						
An exploratory study of radio frequency identification (RFID) adoption in the healthcare industry (Lee & Shim, 2007)	✓	✓						
An integrated model of information systems adoption in small businesses(Thong, 1999)			✓					
Total	**1**	**5**	**8**	**3**	**5**	**3**	**1**	**2**

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APPENDIX F: Environmental Context Variables

	Regulatory Support/governance	Competition Intensity	Attitude to risk	External pressure / institutional pressure	Market Uncertainty	Production and Operations Improvement	Enhancements of Products and Services	Technology Support Infrastructure	Consumer Readiness
Integrative framework for assessing firms' potential to undertake Green IT initiatives via virtualization – A theoretical perspective (Bose & Luo, 2011)	✓	✓							
Commercial adoption of open source software: an empirical study(Glynn, et al., 2005)	✓		✓						
Electronic commerce adoption: an empirical study of small and medium US businesses (Grandon & Pearson, 2004)		✓		social factors, industry pressure					
Unified Modeling Language (UML) IT adoption — A holistic model of organizational capabilities perspective (Gu, et al., 2012)		✓			✓				
Two-Sided Adoption of Mobile Marketing Platforms: Towards an Integrated Conceptual Model (Guo, et al., 2010)	✓	✓							
Migrating to internet-based e-commerce: Factors affecting e-commerce adoption and migration at the firm level(Hong & Zhu, 2006)									
Determinants of the adoption of enterprise resource planning within the Technology-Organisation-Environment framework: Taiwan's communications industry(Pan & Jang, 2008)	✓	✓				✓	✓		
SMEs'e-commerce adoption: perspectives from Denmark and Australia (Scupola, 2009)	✓							✓	
Business-to-business adoption of eCommerce in China (Tan, et al., 2007)	✓				✓			✓	
The moderating effect of the business strategic orientation on eCommerce adoption: Evidence from UK family run SMEs (Wang & Ahmed, 2009)				✓					
Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors (Zhu, et al., 2003)		✓		✓					✓

	Regulatory Support/governance	Competition Intensity	Attitude to risk	External pressure / institutional pressure	Market Uncertainty	Production and Operations Improvement	Enhancements of Products and Services	Technology Support Infrastructure	Consumer Readiness
Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry (Zhu, et al., 2004)	✓	✓							
A cross-country study of electronic business adoption using the technology-organization-environment framework (Zhu, et al., 2002)		✓		✓					✓
What leads to post-implementation success of ERP? An empirical study of the Chinese retail industry (Zhu, et al., 2010)				✓					
A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework (Kuan & Chau, 2001)	✓			✓					
An exploratory study of radio frequency identification (RFID) adoption in the healthcare industry (Lee & Shim, 2007)				✓	✓				
An integrated model of information systems adoption in small businesses (Thong, 1999)		✓							
Total	**8**	**9**	**1**	**7**	**3**	**1**	**1**	**2**	2

APPENDIX G: Summary of Pre-test Changes

Item Code	Item Before Pre-test	Item Post Pre-test	Changes Made & Rationale
PDB1	Quicken response time to patient requests	Decrease physician time per patient encounter	Item rephrased
PDB2	Increase interaction amongst physicians across the enterprise	Improve the way we communicate with medical service providers (i.e. medical equipment suppliers, medical aid companies or labs)*	Items consolidated*
PDB3	Improve order management/order cycle of medical supplies	Improve management of medical supplies	Item rephrased
PDB4	Improve interaction with patients	*	
PDB5	Improve interaction with suppliers, medical aid companies, labs, etc.	*	
PDB6	Reduce direct operating costs	Reduce the costs of providing patient care and services**	Items consolidated**
PDB7	Improve cash flow management	Help us bill for services more accurately	Item rephrased
		Decrease physician time required to review past medical records	Item added
		Improve our ability to perform chart checks/reminders for follow-ups	Item added
		Provide more rapid access to patient data	Item added
		Help us see another physician's patients more easily	Item added
PIB1	Improve the timelines of patient care		Item dropped
PIB2	Reduce patient care and service costs	**	
PIB3	Improve service productivity of medical staff	Improve service productivity of medical staff	N/A
PIB4	Reduce unnecessary patient transfers or admissions	Reduce unnecessary patient transfers or referrals to other healthcare providers	Item rephrased
PIB5	Improve overall effectiveness of patient care		Item dropped
		Reduce clinical errors	Item added
		Improve accuracy of clinical documentation	Item added
ITI1	We have sufficient experience with network based applications	We have sufficient experience with network based applications	N/A
ITI2	We have sufficient technology resources (hardware and software) to support eHealth systems		Item dropped
ITI3	Our enterprise is well computerized with local and wide area networks	Our enterprise is well computerized with networks	N/A
ITI4	We have high bandwidth connectivity to the Internet	Our enterprise has high bandwidth connectivity to the Internet	Item rephrased
ITS1	All clinical staff (non-support staff) are computer literate	All clinical staff (non-support staff) are computer literate	N/A

Item Code	Item Before Pre-test	Item Post Pre-test	Changes Made & Rationale
ITS2	There is at least one staff member who is a computer expert	There is at least one staff member who is a computer expert.	N/A
ITS3	Our staff's understanding of computers is very good compared with other local medical facilities	Our staff's understanding of computers is very good compared with other local medical facilities	N/A
ITS4	Overall, our technical support staff is knowledgeable when it comes to computer-based systems.		Item dropped
ITS5	Our medical practice possesses a high degree of computer-based technical expertise.		Item dropped
ITS6	We are very knowledgeable about new computer systems for healthcare providers.		Item dropped
ITS7	We have the knowledge to develop and maintain computer-based communication links with other health care providers		Item dropped
CM1	Learning to operate eHealth systems would not be easy for our staff.	Learning to operate eHealth systems would be easy for our clinical staff.	Reverse scoring removed as it was deemed ineffective
CM2	We would find it easy to get eHealth systems to do what we need it to do in our patient care and management		Item dropped
CM3	It is not easy for our staff to become skilful in using eHealth systems	It is easy for our clinical staff to become skilful in using eHealth systems	Reverse scoring removed as it was deemed ineffective
CM4	We find eHealth systems easy to use	Our clinical staff finds eHealth systems easy to use	Item rephrased
SCS1	Lead physicians communicate the importance of the medical enterprise gearing up to meet changing technology trends.	Our senior physicians (physicians in senior management positions) communicate the importance of the medical enterprise gearing up to meet changing technology trends.	Ambiguous item rephrased
SCS2	Lead physicians make an effort to convince other staff members of the benefits of a new technology.	Senior physicians make an effort to convince other staff members of the benefits of new technology.	Ambiguous item rephrased
SCS3	Lead physicians encourage other staff members to use new technology systems.	Senior physicians encourage other staff members to use new technology systems.	Ambiguous item rephrased
SCS4	Lead physicians in this practice are frequently the most ardent champions of new technology systems.	Senior physicians in this practice are frequently the most ardent champions of new technology systems.	Ambiguous item rephrased
RC1	Our medical enterprise has the technological resources required to adopt eHealth systems	Our medical enterprise has the technological resources required to adopt eHealth systems	N/A
RC2	Our medical enterprise has the managerial resources (assignment of personnel to manage or support eHealth systems) to adopt eHealth systems	Our medical enterprise has the managerial resources (assignment of personnel to manage or support eHealth systems) to adopt eHealth systems	N/A

Item Code	Item Before Pre-test	Item Post Pre-test	Changes Made & Rationale
RC3	Our medical enterprise has the financial resources to adopt eHealth systems	Our medical enterprise has the financial resources to adopt eHealth systems	N/A
EP1	Satisfying the needs of our patients is an important factor for implementing eHealth systems.		Item dropped
EP2	Some of our patients demand that we implement eHealth systems	Some of our patients demand that we implement eHealth systems	N/A
EP3	Our relationships with our patients will suffer if we do not implement eHealth systems.	Our relationships with our patients will suffer if we do not implement eHealth systems.	N/A
EP4	Our patients' needs do not influence the design of our eHealth systems	Our patients' needs have a strong influence on the eHealth systems we implement	Reverse scoring removed as it was deemed ineffective
EP5	Having state-of-the art eHealth systems confers status for our medical enterprise with our stakeholders.	Having state-of-the art eHealth systems confers status for our medical enterprise with our stakeholders (medical aid companies, equipment suppliers, laboratories, etc.)	Item rephrased
EP6	Our stakeholders (medical aid companies, equipment suppliers, laboratories, etc.) would perceive our practice/facility as being technologically backward if we did not implement eHealth systems	Our stakeholders (medical aid companies, equipment suppliers, laboratories, etc.) would perceive our practice/facility as being technologically backward if we did not implement eHealth systems	N/A
EP7	If we do not undertake eHealth initiatives, we might lose our edge over competing practices/facilities in the area.	If we do not undertake eHealth initiatives, we might lose our edge over competing practices/facilities in the area.	N/A
EP8	Being ahead of other competing practices/facilities in e-Health is one of our key objectives	Being ahead of other competing practices/facilities in e-Health is one of our key objectives	N/A
RE1	Government drives the use of eHealth systems by providing incentives	Government is adequately driving the use of eHealth systems by providing incentives	N/A
RE2	Government demonstrates a strong commitment to promote the use of eHealth	Government demonstrates a strong commitment to promote the use of eHealth	N/A
RE3	There are effective laws that support eHealth	There are effective laws *(e.g. with regard to privacy of patient information)* that support eHealth	Item rephrased
RE4	There are effective laws to protect patient privacy		Item dropped
RE5	Government policy restricts how long eHealth systems can keep the information they gather about patients		Item dropped
RE6	There are laws that state that medical enterprises have no right to share eHealth information collated from patients		Item dropped

APPENDIX H: Cover Letter



Dear Doctor / Practice Manager / Practice Administrator

My name is Motlatsi Mamatela. I am completing my Master of Commerce degree in Information Systems at the University of the Witwatersrand, Johannesburg. For the purposes of my degree, I am conducting a study of the technological, organisational and environmental factors that influence the propensity of medical enterprises, such as your own, to adopt eHealth technologies.

eHealth is the use of electronic communications and information technology to transfer, store and retrieve clinical data and/or to assist and improve clinical, educational, communication and administrative functions within the healthcare enterprise. eHealth includes, but is not limited to electronic health records, ePrescription, ePayment, decision support systems, etc.

Understanding the adoption of these technologies will help us to explain the inhibiting factors that are exhibited by enterprises with low propensities to adopt and the enabling factors exhibited by enterprises with a high propensity to adopt. The aim is to identify factors which need to be introduced or eliminated in clinical processes to facilitate their integration with IT, thus improving eHealth maturity in our country.

You, your practice administrator or practice manager are hereby invited to participate in this study because of your roles as decision makers in your medical practice. The survey is accessible in 3 formats: i) an online survey ii) a faxed form or iii) mailed or hand-delivered form. If you choose to participate, the survey should take 10-15 minutes to complete. The survey consists of 8 demographic questions, 39 questions which you are asked to rate on a scale, and 2 questions asking you to indicate the types of IT systems in place within your practice and their usage.

Please note that participation is entirely voluntary. No risks, penalties or losses will be incurred if you opt not to participate in the study. This questionnaire is for research purposes only. There are no right or wrong answers. All responses will be kept strictly confidential. Moreover, all responses are anonymous as you are not asked to provide any information that can be used to identify your medical practice. Results will only be reported in the aggregate and a copy of the report will be made available to respondents on request. All data will be destroyed once the University requirements have been met. You have the right to withdraw your participation at any stage. Choosing to proceed with the survey will be taken as your consent.

Please copy and paste this URL: [survey URL] into your web browser to proceed to the online survey.

This study was approved unconditionally by the research ethics committee of the School of Economic and Business Sciences, protocol number: CINFO/1022.

Thank you for considering your participation. For any questions or queries, please contact me at telephone number [telephone number], fax number [fax number] or email [email address]

Regards,
Motlatsi Mamatela
MCom Student
School of Economic and Business Sciences
University of the Witwatersrand, Johannesburg

Supervisor: Prof Jason Cohen [supervisor's email address] or [supervisor's telephone number]

APPENDIX I1: Final Questionnaire

eHealth, as defined by the World Health Organisations is the transfer of health resources and health care by electronic means. It encompasses three main areas namely:

a. The delivery of health information, for health professionals and health consumers, through the Internet and telecommunications.
b. Using the power of IT and e-commerce to improve public health services, e.g. through the education and training of health workers.
c. The use of e-commerce and e-business practices in health systems management.

This questionnaire, which consists of 4 sections, relates to your medical enterprise's current use of eHealth technologies.

Section A gathers your enterprise's demographic information and consists of 8 questions.

Sections B, C and D consist of statements to which you are required to indicate your level of agreeableness by selecting the appropriate option

- Section B (2 questions & 22 statements) pertains to the current use of technology systems within your enterprise.
- Section C (7 statements) contains general questions relating to the organisational factors that influence your decision to procure health systems
- Section D (10 statements) determines how external industry factors influence your use of technology systems within your enterprise.

The survey should take 10-15 minutes to complete.

SECTION A: DEMOGRAPHIC INFORMATION

Instruction: Please provide the following demographic information about yourself and your medical enterprise.

a. Job title / Role in medical practice ☐

b. How long have you been working for this medical enterprise? ☐ Years
c. How long have you been in your current role? ☐ Years
d. How long has your medical enterprise been in operation? ☐ Years

e. In which province is your medical enterprise located? ☐

f. Which of the following best describes your medical enterprise's speciality?

☐ General Medicine / Family Medicine	☐ Dental Therapy & Oral Hygiene	☐ Dietetics and Nutrition
☐ Medical Technology	☐ Occupational Therapy, Medical Orthotics & Prosthetics	☐ Optometry & Dispensing Opticians
☐ Physiotherapy	☐ Podiatry	☐ Bio-kinetics
☐ Psychology	☐ Psychiatry	☐ Speech, Language and Hearing Therapy
☐ Emergency Care	☐ Radiography, Radiology and Clinical Technology	☐ Internal Medicine
☐ Pathology	☐ Environmental Health	☐ Paediatrics
☐ Dermatology	☐ Cardiology	☐ Pulmonology
☐ Neurology	☐ Endocrinology	☐ Gynaecology & Obstetrics
☐ Otorhinolaryngology (ENT(ear, nose, throat) Specialists)	☐ Chiropractic Therapy	☐ Other, please specify:

g. Please indicate the total number of employees (healthcare professionals, administrative and support staff) within your medical enterprise

- ○ 1-2
- ○ 3-5
- ○ 6-10
- ○ 11-15
- ○ 16-20
- ○ 21-25
- ○ More than 25

h. Please indicate the average number of patients serviced at this medical enterprise/practice on a monthly basis

SECTION B: TECHNOLOGICAL FACTORS

This set of questions asks about your medical enterprise / practice's experience with eHealth technologies as well as your attitudes toward eHealth technologies.

a. Please indicate if your medical enterprise/practice uses the following eHealth applications. Where applicable, please indicate the length of the time that the technology has been in use in your medical practice.

	In Use		**In Use (Number of Years)** **Please indicate "DK" if you don't know the length of time that the technology has been in use.**
	Yes	**No**	
1.1. Electronic records for patients' demographic related information	○	○	
1.2. Electronic records for patient assessment /clinical notes	○	○	
1.3. Electronic records for patient financial and fee related information	○	○	
2.1. Electronic ordering of laboratory tests	○	○	
2.2. Electronic ordering of imaging tests *(i.e. X-rays, CT scans, MRI scans, etc.)*	○	○	
3.1. Electronic access to laboratory tests results	○	○	
3.2. Electronic access to imaging test results *(i.e. X-rays, CT scans, MRI scans, etc.)*	○	○	
4.1. Electronic medical aid claims submission systems	○	○	
4.2. EFT (Electronic Fund Transfer) systems	○	○	
5. Practice administration information systems *(i.e. appointment booking / patient scheduling systems)*	○	○	
6. e-Prescription systems *(i.e. a system that allows clinicians to write and send prescriptions to a participating pharmacy electronically instead of using handwritten or faxed notes or calling in prescriptions)*	○	○	
7. Business productivity software *(such as Microsoft Word or Excel)*used by clinical staff	○	○	
8. Clinical Decision Support systems to support diagnostic decisions or patient care plans	○	○	
9. Online medical reference / knowledge repository (for drugs, clinical guidelines) *(e.g. Medline)*	○	○	

Are you using any eHealth technologies not listed above? If so, please specify which technologies you are using and how long you have been using them in your practice.

b. Please indicate the number of full-time and part-time employees (healthcare professionals and administrative staff) within your medical enterprise who use/access any of the existing electronic health systems identified above

- ○ 1-2
- ○ 3-5
- ○ 6-10
- ○ 11-15
- ○ 16-20
- ○ 21-25
- ○ More than 25

Please rate the degree to which you agree with the following statements:

Our medical enterprise perceives eHealth as a technology that can enable us to:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
1. Decrease physician time required to review past medical records compared to paper-based records							
2. Decrease physician time per patient encounter							
3. Improve our ability to perform reminders for follow-ups							
4. Provide more rapid access to patient data than paper-based records							
5. Help us see another physician's patients more easily							
6. Improve the way we communicate with medical service providers (i.e. medical equipment suppliers, medical aid companies or labs)							
7. Reduce the costs of providing patient care and services							
8. Help us bill for services more accurately							
9. Improve management of medical supplies							
10. Improve service productivity of medical staff							
11. Reduce clinical errors							
12. Improve accuracy of clinical documentation							
13. Reduce unnecessary patient transfers or referrals to other healthcare providers							

Please rate the degree to which you agree with the following statements relating to your medical enterprise/ practice's experience with information technology:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
14. We have sufficient experience with network based applications							
15. Our enterprise is well computerized with networks							
16. Our enterprise has high bandwidth connectivity to the Internet							
17. We are confident that our clinical staff (non-support staff) are proficient with computers							
18. There is at least one staff member who is a computer expert.							
19. Our staff's understanding of computers is very good compared with other local medical facilities							
20. Learning to operate eHealth systems would be easy for our clinical staff.							
21. It is easy for our clinical staff to become skilful in using eHealth systems							
22. Our clinical staff finds eHealth systems easy to use							

SECTION C: ORGANISATIONAL FACTORS

Please rate the degree to which you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
1. Our senior clinicians (clinicians in charge of this practice) communicate the importance of the medical enterprise gearing up to meet changing technology trends.							
2. Senior clinicians make an effort to convince other staff members of the benefits of new technology.							
3. Senior clinicians encourage other staff members to use new technology systems.							
4. Senior clinicians in this practice are frequently the most ardent champions of new technology systems.							
5. Our medical enterprise has the technological resources required to make use of eHealth systems							
6. Our medical enterprise has the managerial resources (assignment of personnel to manage or support eHealth systems) to make use of eHealth systems							
7. Our medical enterprise has the financial resources to make use of eHealth systems							

SECTION D: ENVIRONMENTAL FACTORS

Please rate the degree to which you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
1. Some of our patients demand that we implement eHealth systems							
2. Our relationships with our patients will suffer if we do not implement eHealth systems.							
3. Our patients' needs have a strong influence on the eHealth systems we implement							
4. Having state-of-the art eHealth systems confers status for our medical enterprise with our stakeholders (medical aid companies, equipment suppliers, laboratories, etc.)							
5. Our stakeholders (medical aid companies, equipment suppliers, laboratories, etc.) would perceive our practice/facility as being technologically backward if we did not implement eHealth systems							
6. If we do not undertake eHealth initiatives, we might lose our edge over competing practices/facilities in the area.							
7. Being ahead of other competing practices/facilities in the use of e-Health is one of our key objectives							
8. Government is adequately driving the use of eHealth systems by providing incentives							
9. Government demonstrates a strong commitment to promote the use of eHealth							
10. There are effective laws *(e.g. with regard to privacy of patient information)* that support eHealth							

	YES	NO
Please indicate if you would like to receive the results of this survey		

If YES, please provide an email address (or fax number) to which results of the survey can be sent.

Thank you for completing this questionnaire. For any questions and queries related to the research, please contact me at telephone number [telephone number], fax number [fax number], or email me at [email address]

APPENDIX I2: QUESTIONNAIRE ITEM MEANS

Item	Item Description	Mean	Standard Deviation
PDB1	Decrease physician time required to review past medical records compared to paper-based records	5.03	1.585
PDB2	Decrease physician time per patient encounter	3.97	1.778
PDB3	Improve our ability to perform reminders for follow-ups	5.73	1.146
PDB4	Provide more rapid access to patient data than paper-based records	5.86	1.139
PDB5	Help us see another physician's patients more easily	4.92	1.497
PDB6	Improve the way we communicate with medical service providers (i.e. medical equipment suppliers, medical aid companies or labs)	5.79	1.119
PDB7	Reduce the costs of providing patient care and services	4.53	1.615
PDB8	Help us bill for services more accurately	5.90	1.193
PDB9	Improve management of medical supplies	5.18	1.338
PIB1	Improve service productivity of medical staff	5.22	1.300
PIB2	Reduce clinical errors	4.73	1.527
PIB3	Improve accuracy of clinical documentation	5.05	1.475
PIB4	Reduce unnecessary patient transfers or referrals to other healthcare providers	4.42	1.508
ITI1	We have sufficient experience with network based applications	4.09	1.633
ITI2	Our enterprise is well computerised with networks	4.28	1.740
IT13	Our enterprise has high bandwidth connectivity to the Internet	4.91	1.840
ITS1	We are confident that our clinical staff (non-support staff) are proficient with computers	5.02	1.630
ITS2	There is at least one staff member who is a computer expert.	4.45	1.826
ITS3	Our staff's understanding of computers is very good compared with other local medical facilities	4.42	1.518
CM1	Learning to operate eHealth systems would be easy for our clinical staff.	4.85	1.469
CM2	It is easy for our clinical staff to become skilful in using eHealth systems	4.99	1.378
CM3	Our clinical staff finds eHealth systems easy to use	4.59	1.461
SCS1	Our senior clinicians (clinicians in charge of this practice) communicate the importance of the medical enterprise gearing up to meet changing technology trends.	4.77	1.361
SCS2	Senior clinicians make an effort to convince other staff members of the benefits of new technology.	4.70	1.445
SCS3	Senior clinicians encourage other staff members to use new technology systems.	4.83	1.348
SCS4	Senior clinicians in this practice are frequently the most ardent champions of new technology systems.	4.43	1.477
RC1	Our medical enterprise has the technological resources required to make use of eHealth systems	4.85	1.404
RC2	Our medical enterprise has the managerial resources (assignment of personnel to manage or support eHealth systems) to make use of eHealth systems	4.65	1.523
RC3	Our medical enterprise has the financial resources to make use of eHealth systems	4.45	1.585
EP1	Some of our patients demand that we implement eHealth systems	2.73	1.493
EP2	Our relationships with our patients will suffer if we do not implement eHealth systems.	3.29	1.745
EP3	Our patients' needs have a strong influence on the eHealth systems we implement	3.91	1.739
EP4	Having state-of-the art eHealth systems confers status for our medical enterprise with our stakeholders (medical aid companies, equipment suppliers, laboratories, etc.)	4.25	1.530
EP5	Our stakeholders (medical aid companies, equipment suppliers,	4.20	1.592

	laboratories, etc.) would perceive our practice/facility as being technologically backward if we did not implement eHealth systems		
EP6	If we do not undertake eHealth initiatives, we might lose our edge over competing practices/facilities in the area.	4.20	1.780
EP7	Being ahead of other competing practices/facilities in the use of e-Health is one of our key objectives	4.05	1.765
RE1	Government is adequately driving the use of eHealth systems by providing incentives	2.75	1.494
RE2	Government demonstrates a strong commitment to promote the use of eHealth	2.81	1.472
RE3	There are effective laws (e.g. with regard to privacy of patient information) that support eHealth	4.16	1.559

APPENDIX J: Ethics Clearance Form

SCHOOL OF
Economic & Business Sciences

Faculty of Commerce, Law and Management
University of the Witwatersrand, Johannesburg

Division of Information Systems
Private Bag X3, WITS, 2050, South Africa • Telephone: +27 11 717 8160 • Fax: +27 11 717 8139
email: sibongile.dhladhla@wits.ac.za

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

CLEARANCE CERTIFICATE **PROTOCOL NUMBER: CINFO/1022**

PROJECT

An empirical study of the technological, organisational and environmental factors influencing South African medical enterprise's propensity to adopt eHealth Technologies.

INVESTIGATORS	Motlatsi Mamatela
DEPARTMENT	Information Systems
DATE CONSIDERED	25.04.2013
DECISION OF THE ETHICS COMMITTEE	Approved Unconditionally

NOTE

Unless otherwise specified this ethics clearance is valid for 1 year and maybe renewed upon application

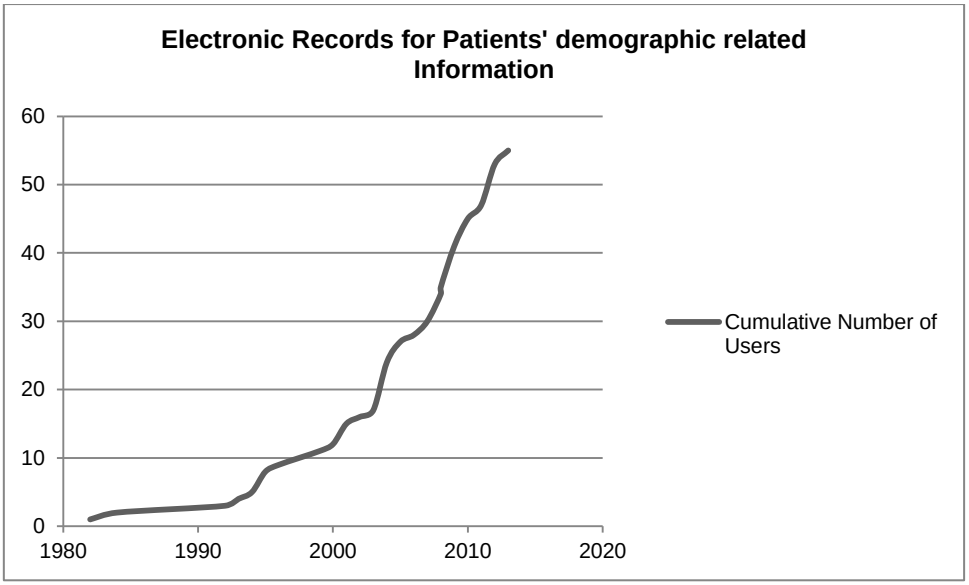
DATE 25 April 2013 **CHAIRPERSON: Mr. J Bancilhon**

APPENDIX K: DIFFUSION CURVE EXAMPLE DATA

Electronic Records for Patient's demographic related Information.

Year*	Years In Use	Frequency	Percent	Cumulative Number of Users**	Valid	Cumulative Percent
2013	1	2	1.5	55	3.6	3.6
2012	2	6	4.6	53	10.9	14.5
2011	3	2	1.5	47	3.6	18.2
2010	4	4	3.1	45	7.3	25.5
2009	5	6	4.6	41	10.9	36.4
2008	5.5	1	.8	35	1.8	38.2
2008	6	4	3.1	34	7.3	45.5
2007	7	2	1.5	30	3.6	49.1
2006	8	1	.8	28	1.8	50.9
2005	9	3	2.3	27	5.5	56.4
2004	10	7	5.4	24	12.7	69.1
2003	11	1	.8	17	1.8	70.9
2002	12	1	.8	16	1.8	72.7
2001	13	3	2.3	15	5.5	78.2
2000	14	1	.8	12	1.8	80.0
1999	15	2	1.5	11	3.6	83.6
1996	18	1	.8	9	1.8	85.5
1995	19	3	2.3	8	5.5	90.9
1994	20	1	.8	5	1.8	92.7
1993	21	1	.8	4	1.8	94.5
1992	22	1	.8	3	1.8	96.4
1984	30	1	.8	2	1.8	98.2
1982	32	1	.8	1	1.8	100.0
	Total	55	42.3		100.0	
	Not Using / Unreported	75	57.7			
	N	130	100.0			

*x-axis data for diffusion graph
**y-axis data for diffusion graph


Electronic Records for Patients' demographic related Information
60
50
40
30
20
10
0
1980
1990
2000
2010
2020
Cumulative Number of Users

APPENDIX L: ASSUMPTIONS OF MULTIPLE REGRESSION

1. COLLINEARITY

To test for multi-collinearity, the inter-item correlation matrix was examined (Refer to Section 4.6 Table 20 for the inter-item correlation matrix). There was no presence of high correlations (0.700 and higher)(Williams, et al., 2006) indicating absence of multi-collinearity. Additionally, multi-collinearity was examined using the Tolerance parameter and its inverse the Variance Inflation Factor (VIF). Tolerance is defined as the "amount of variability of the selected independent variables not explained by the other independent variables". Although a cut-off threshold of a VIF value of 10 is commonly used (Hair, et al., 2006), this study has a relatively small sample size and there is a risk of increased standard errors due to multi-collinearity. As such VIF values close to 0 and less than 5, and Tolerance scores close to 1 are used to indicate that the collinearity of the independent variables is not problematic. Refer below for the VIF and Tolerance scores of each variable in each regression model. These did not indicate the presence of multi-collinearity and thus the assumption was not violated.

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	isDecade1	.220	4.543
	isDecade2	.249	4.024
	isDecade3	.357	2.800
2	(Constant)		
	isDecade1	.214	4.672
	isDecade2	.243	4.122
	isDecade3	.357	2.800
	CompositePB	.831	1.204
	CompositeITI	.740	1.351
	CompositeCM	.696	1.437
3	(Constant)		
	isDecade1	.211	4.736
	isDecade2	.238	4.210
	isDecade3	.352	2.841
	CompositePB	.792	1.262
	CompositeITI	.611	1.638
	CompositeCM	.562	1.779
	TransformSIZE	.838	1.193
	CompositeSCS	.620	1.612
	CompositeRC	.622	1.608
4	(Constant)		
	isDecade1	.205	4.874
	isDecade2	.233	4.295
	isDecade3	.349	2.868
	CompositePB	.703	1.423
	CompositeITI	.595	1.681

Model		Collinearity Statistics	
		Tolerance	VIF
	CompositeCM	.548	1.825
	TransformSIZE	.826	1.211
	CompositeSCS	.600	1.667
	CompositeRC	.620	1.614
	CompositeEP	.695	1.438
	CompositeRE	.893	1.120
a. Dependent Variable: PTA			

PB=Perceived Benefits; ITI=IT Infrastructure; CM=Complexity; SCS=Senior Clinician Involvement; RC=Resource Commitment; EP= External Pressure; RE= Regulatory Environment; PTA= Propensity to Adopt

2. ASSUMPTION OF LINEAR RELATIONSHIPS

The linearity of the relationship between the dependent and the independent variables represents the degree to which the change in the dependent variable is associated with the independent variable. Scatterplots were used to examine the bivariate relationship between each independent variable in the analysis and the dependent variable. The scatter plots were examined and did not exhibit any non-linear pattern. Thus, the assumption of linearity has not been violated.

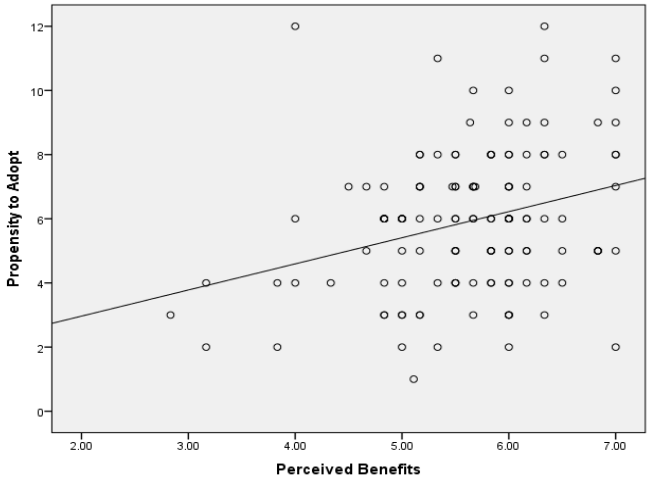


Figure 11: Scatter plot PTA-PB

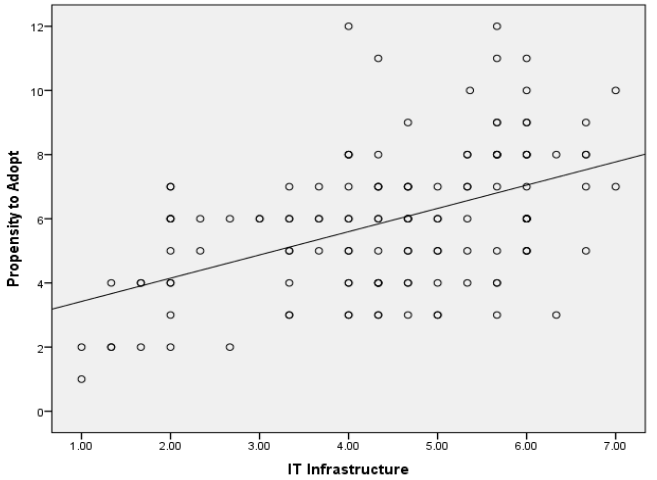


Figure 12: Scatter plot PTA-ITI

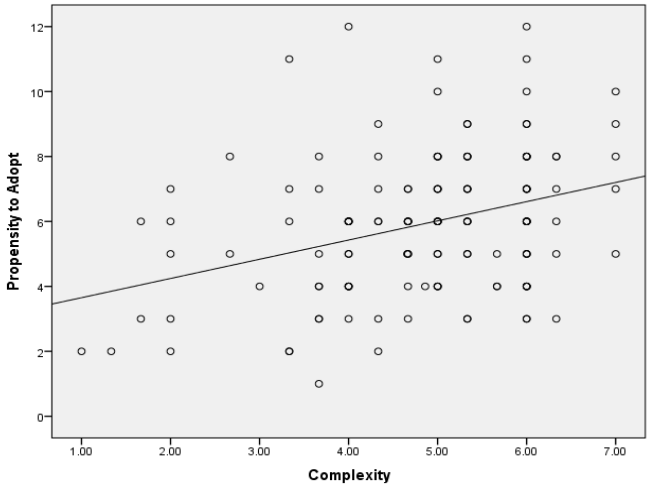


Figure 13: Scatter plot PTA-CM

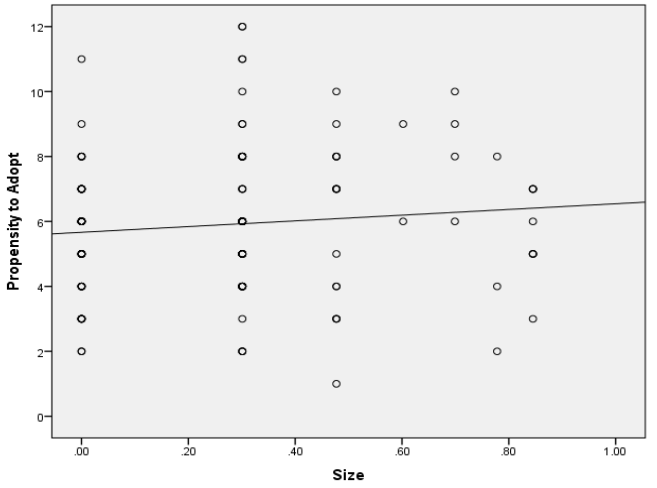


Figure 14: Scatter plot PTA-SIZE

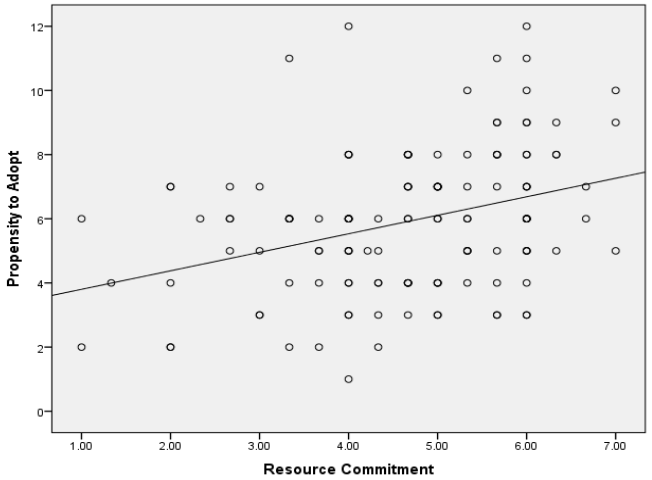


Figure 15: Scatter plot PTA- RC

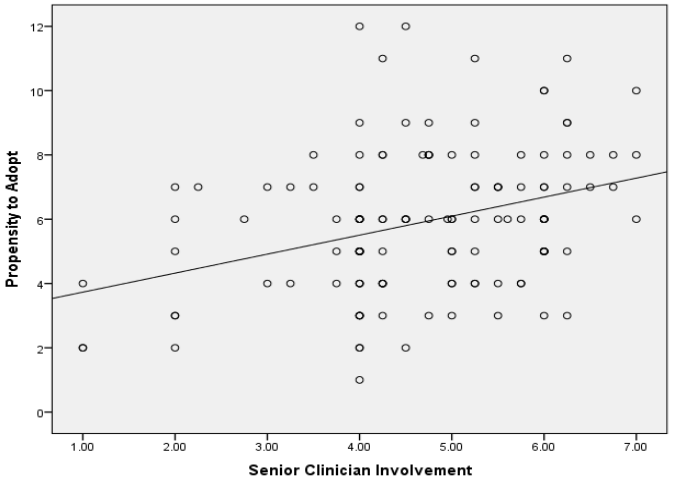


Figure 16: Scatter plot PTA-SCS

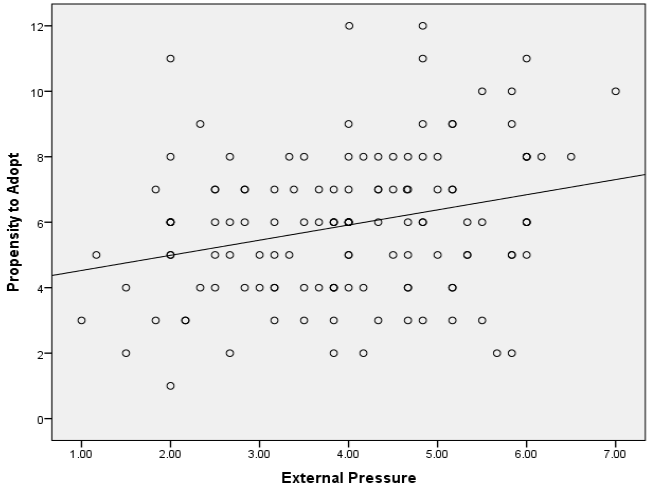


Figure 17: Scatter plot PTA-EP

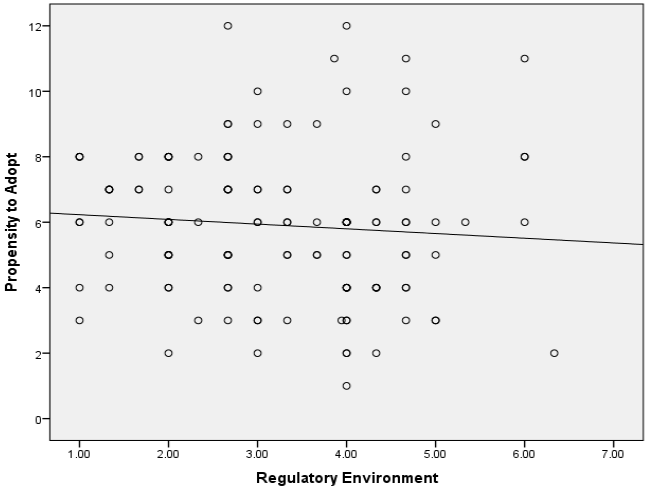


Figure 18 : Scatter plot PTA-RE

3. ASSUMPTION OF HOMOSCEDASTICITY

Homoscedasticity means that the variance of errors across all levels of the independent variables is constant. The assumption of homoscedasticity was checked by visually examining a plot of the standardised residuals on the regression standardised predicted values. Residuals were randomly distributed around 0 and were not distributed in a fan or bow-tie shape. Thus, the assumption of homoscedasticity has not been violated.

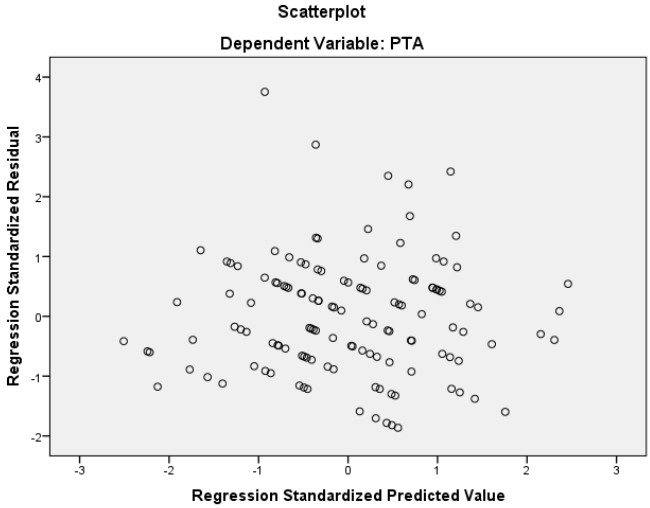


Figure 19: Scatter plot of the Standardised Residuals on the Standardised Predicted Values

4. NORMALITY OF THE RESIDUAL DISTRIBUTION

The probability plots of the residuals were examined. To determine normal distribution, the extent to which the plots for the residuals coincide with the line of expected values was evaluated. It was noted that there was no extreme deviation of the residuals from the line of expected values. The histogram was also examined and it displayed the shape of a normal distribution curve. Thus, the assumption of normality has not been violated.

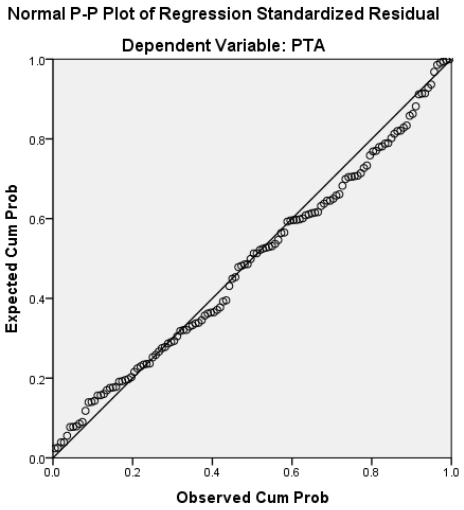


Figure 20: Normality: P-P Plot

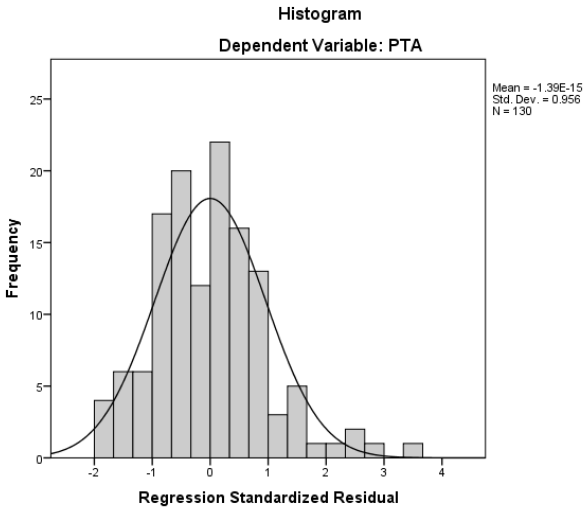


Figure 21: Normality: Histogram

APPENDIX M: T-TESTS FOR INDIVIDUAL SIGNIFICANCE

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.000	.770		5.195	.000
	isDecade1	2.194	.815	.491	2.693	.008
	isDecade2	2.216	.849	.448	2.610	.010
	isDecade3	1.056	.925	.163	1.141	.256
2	(Constant)	-.784	1.318		-.595	.553
	isDecade1	2.026	.718	.453	2.822	.006
	isDecade2	1.960	.747	.396	2.624	.010
	isDecade3	1.092	.804	.169	1.357	.177
	CompositePB	.296	.226	.107	1.309	.193
	CompositeITI	.632	.130	.419	4.851	.000
	CompositeCM	.100	.155	.057	.642	.522
3	(Constant)	-1.300	1.333		-.975	.331
	isDecade1	2.175	.718	.487	3.032	.003
	isDecade2	1.923	.749	.388	2.566	.012
	isDecade3	.922	.804	.142	1.146	.254
	CompositePB	.230	.230	.083	1.003	.318
	CompositeITI	.560	.142	.371	3.933	.000
	CompositeCM	.054	.172	.031	.315	.753
	TransformSIZE	1.110	.702	.127	1.581	.117
	CompositeSCS	.190	.163	.109	1.165	.246
	CompositeRC	.039	.160	.023	.246	.806
4	(Constant)	-.638	1.370		-.466	.642
	isDecade1	2.175	.720	.487	3.021	.003
	isDecade2	1.970	.748	.398	2.632	.010
	isDecade3	.932	.799	.144	1.166	.246
	CompositePB	.152	.241	.055	.632	.529
	CompositeITI	.554	.143	.367	3.882	.000
	CompositeCM	.004	.172	.002	.022	.983
	TransformSIZE	.937	.700	.107	1.338	.183
	CompositeSCS	.159	.164	.091	.969	.335
	CompositeRC	.061	.159	.035	.381	.704
	CompositeEP	.230	.148	.136	1.550	.124
	CompositeRE	-.243	.136	-.139	-1.795	.075
a. Dependent Variable: PTA						

PB=Perceived Benefits; ITI=IT Infrastructure; CM=Complexity; SCS=Senior Clinician Involvement; RC=Resource Commitment; EP= External Pressure; RE= Regulatory Environment; PTA= Propensity to Adopt