

Critical success factors for Telemedicine Centres in African countries

LIEZEL CILLIERS

University of Fort Hare



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*Critical success factors for Telemedicine
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Liezel Cilliers

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Critical Success Factors for User Acceptance of Telemedicine in South Africa

Abstract

The World Health Organization has recommended Telemedicine to improve health care in developing countries. The objective of this study was to produce Critical Success Factors that will investigate and identify factors that influence the acceptance and continued use of Telemedicine in the Eastern Cape Department of Health, and to suggest ways to sustain this technology from initial adoption (the pilot programme) to full adoption. Sub questions investigated which other facilitating factors, such as management support or previous Information Technology exposure must be present in order for the technology to be adopted successfully. The study made use of a questionnaire to investigate the user acceptance and behaviour of health care workers. A return rate of 76% was achieved. The data was analysed making use of Statistical Package for the Social Sciences (SPSS), specifically the Chi Square test. From these results Critical Success Factors were then formulated to address the problems identified. The Critical Success Factors that were identified include:

- Implement and disseminate best practice within a legislative framework;
- Find a champion;
- Change management strategies;
- Training;
- Sustainable finance;
- Technical issues and
- Project management principles

If these CSFs are addressed before and during the implementation of Telemedicine it will increase the acceptance and use of the technology among health care workers.

Critical Success Factors for User Acceptance of Telemedicine in South Africa

Declaration

I, LIEZEL CILLIERS, hereby declare that:

- The work in this dissertation is my own work.
- All sources used or referred to have been documented and recognised.
- This dissertation has not previously been submitted in full or partial fulfilment

of the requirements for an equivalent or higher qualification at any other
recognised educational institution.

L CILLIERS

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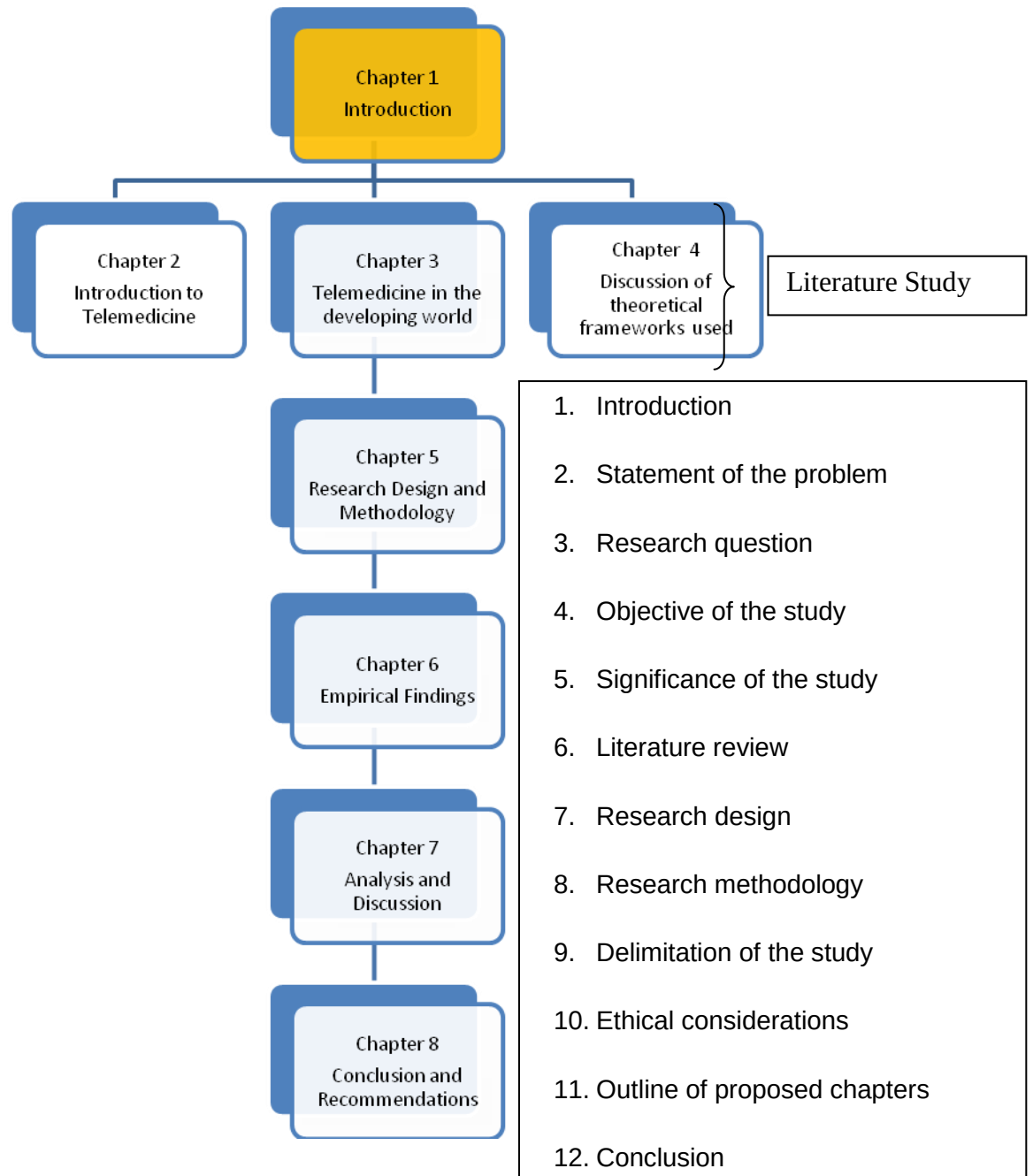
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Chapter 1

Introduction



Critical Success Factors for User Acceptance of Telemedicine in South Africa

1.1 INTRODUCTION

In South Africa the medical care in urban areas can be compared to the best in the world, while in the rural areas millions of people are without access to even the most basic health care services. Shortage of staff, urbanization of specialist services and long distances to travel in order to access health care in rural areas are often identified as the reasons for this imbalance (Telemedicine, 2002; Nwabueze, Meso, Kifle, Okoli and Chutstz, 2009).

The Eastern Cape is the second largest province in terms of land area and the third largest in terms of population in South Africa. It has a population of approximately 7 million people (SouthAfrica.info, 2007).

The East London Hospital Complex (ELHC) is situated in the Central region of the Eastern Cape. It is classified as a public hospital and provides specialist health care services and training in 19 specialist clinical areas. The ELHC therefore plays a central role in the health network of the entire region which serves 3 million people (Njamela, 2006). The Eastern Cape is burdened with a severe shortage of medical staff. A report in 2006 stated that 30% of doctor's posts, 37% of nursing posts, and 80% of specialists' posts were vacant in the ELHC. In some rural hospitals the doctor: patient ratio is 14 times below the national standard reported for South Africa (Medecins San Frontier, 2007a).

Information and Communication Technology (ICT) has the potential to improve equity in underserved rural areas. The World Health Organisation (WHO) has identified Telemedicine as a possible application to strengthen health systems and improve the quality of health care delivery (Nwabueze *et al*, 2009). These benefits typically include improved patient care such as safety, quality and efficiency as well as providing evidence and data to support clinical practice, research and policy (Pagliari, Sloan, Gregor, Sullivan, Detmer, Kahan, Oortwijn and MacGillivray, 2005).

According to the WHO, South Africa is one of the leaders in Telemedicine among developing countries with 30 operational sites offering a range of services in 2001 (Strachan, 2001). The Eastern Cape was one of the first provinces to pilot Telemedicine and has established 12 sites since 1999 (Khumalo, 2004). But despite the backing of the National Department of Health and

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Medical Research Council to introduce Telemedicine to improve health care in rural areas the uptake of Telemedicine has been limited at best. As a result, the National Department of Health's pilot projects have not expanded into a national programme as envisaged (Jack and Mars, 2008).

Possible reasons for this can be found in literature which reports several obstacles to the effective implementation of Telemedicine. These include legislation, infrastructure and human or cultural factors. Human factors such as user acceptance of new technology, motivation, support and training of staff must be addressed before Telemedicine can be efficiently implemented (Chetty, 2005; Medecins Sans Frontiers, 2007a).

In order to realise the full potential and provide value for the financial investment made, Telemedicine in the Eastern Cape must be used continually and effectively by health care providers. Only with technology adoption and continued use will Telemedicine make a difference to the health care in the Eastern Cape. This study aims to investigate and predict factors that affect the adoption and continued use of Telemedicine in the Eastern Cape in order to improve health care services.

1.2 STATEMENT OF THE PROBLEM

Telemedicine has been introduced at 6 District Hospital and 25 clinic sites around the Eastern Cape in the past 5 years with plans to roll out more sites in 2010. These pilot sites have not produced the desired results and it was found that the technology was underutilized or not used at all. Therefore, an investigation is needed before any financial investment is made in further sites (Telemedicine Operation Plan E-health, 2009).

The Lewin Group (2000) suggested in their report that user acceptance by health care workers was the second biggest threat after the availability of appropriate technology to the successful implementation of Telemedicine. This is supported by Pagliari *et al* (2005) and Nwabueze *et al* (2009) who found that user acceptance and implementation of technology can be an obstacle to the acceptance and continued use of Telemedicine. The context into which the new technology is introduced will influence the perceived value of the technology and the subsequent continued use including the cultural factors and the efficacy of the technology transfer (Nwabueza *et al*, 2009). The benefits provided by Telemedicine are well documented in literature, but to achieve these, the technology must be accepted by the end users and utilized optimally.

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1.3 RESEARCH QUESTION

What critical success factors will influence the acceptance and continued use of Telemedicine in the Eastern Cape Department of Health?

In order to answer the above research question, the following sub research questions will be addressed:

1. *What facilitating conditions are necessary for the adoption and continued use of Telemedicine in the Eastern Cape?*

This research question will look at facilitating conditions which can assist or provide barriers in the successful adoption of the technology.

2. *What effect does management support have on the decision to make use of Telemedicine?*

This research question will address what support is needed from management regarding institutional policies and administrative support to promote the continued use of Telemedicine.

3. *What role does previous exposure to Information Technology have on the user that will help predict the likelihood of Telemedicine being adopted and used?*

This research question will provide an insight into the computer literacy level and ICT experience of health care workers in the Eastern Cape and the contribution to the perceptions that this has on the user's ease of use of Telemedicine.

The questions above will be answered making use of data that will be obtained making use of a questionnaire. The information obtained from the questionnaire will be analysed making use of the Technology Acceptance and Unified Theory of the Acceptance and Use of Technology which will be discussed in subsequent chapters.

1.4 OBJECTIVE OF THE STUDY

The objective of the study is to produce Critical Success Factors that will investigate and identify factors that influence the acceptance and continued use of Telemedicine in the Eastern Cape, and to suggest ways to sustain this technology use from initial adoption (the pilot programme) to full adoption.

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1.5 SIGNIFICANCE OF THE STUDY

Populations are becoming increasingly ill due to the burden of HIV/AIDS and lifestyle diseases. Rural health care workers are challenged to coordinate medical services in rural areas with limited resources while case management is becoming increasingly more complex. In the Eastern Cape there is a major drain of health care workers from the rural to the urban areas. Some of the reasons being cited for this trend include professional isolation from peers and long distances to travel for meetings and knowledge transfer.

Telemedicine can alleviate the above situation if it is introduced into the rural areas of the Eastern Cape. The technology must be accepted and continually used by the health care workers in order to realise the benefits (Telemedicine Operational Plan E-health, 2009).

The Technology Acceptance Model (TAM) can be used to predict technology use and acceptance. Literature results however show that research conducted in developing and developed countries cannot be compared as the focus of the studies tend to differ significantly. In two different studies it was found that in Africa *perceived ease of use* was the main determinant of whether Telemedicine would be accepted and used by the participants. In contrast *perceived usefulness* was the main determinant in Western countries (Schepers and Wetzels, 2007). Averweg (2008) reported similar results when comparing the results of studies conducted in Western countries and countries in Africa. Averweg (2008) found that *perceived ease of use* was the main determinant of acceptance in South Africa whereas the main determinant in the majority of studies conducted in Western countries was *perceived usefulness*. The researcher went on to state that it is important to consider the influence of local conditions on the adoption and assimilation of technologies in developing countries.

This study will use Telemedicine to investigate the different facilitating conditions which are necessary to implement and increase the user acceptance of the technology as well as the role that management support plays in achieving the above. Finally acceptance and continued use of technology will provide an insight into the role that previous exposure to Information Technology plays. This study will add to the body of knowledge about the adoption factors of technology already known in the African setting.

1.6 LITERATURE REVIEW

This section introduces the main theories and literature on technology acceptance and continued use.

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1.6.1 Technology Acceptance Model

The Technology Acceptance Model (TAM) was developed by Davis in 1986 and is one of the most cited theoretical frameworks (Teo, 2009). It is used to depict the *perceived usefulness* and *perceived ease of use* that will ultimately determine the user's intention to make use of new technology and can therefore be used to predict and validate the factors that will influence technology adoption, acceptance and use. The model is depicted in Figure 1.

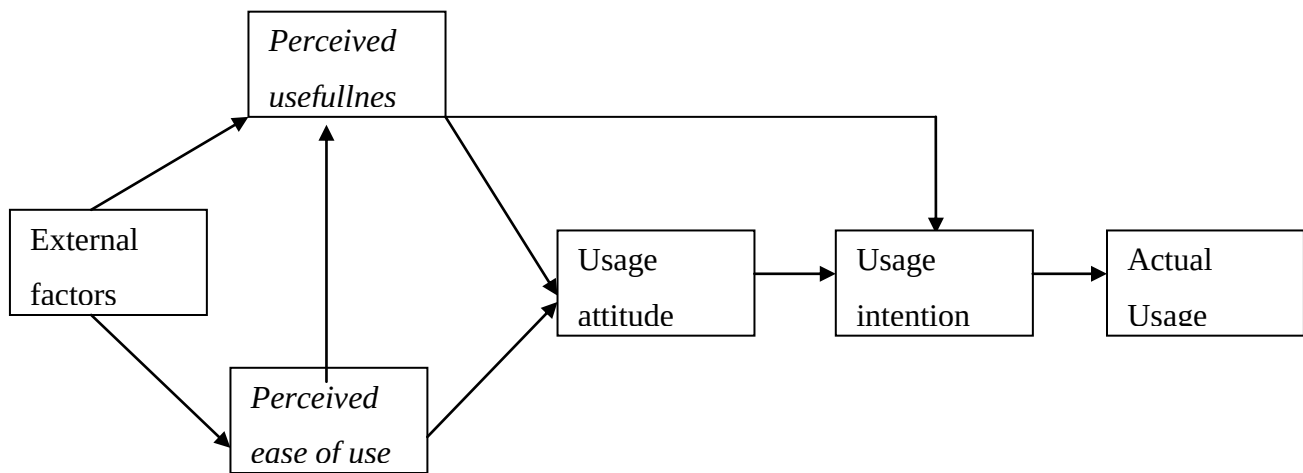


Figure 2: Technology Acceptance Model (Davis, 1989)

TAM has been used to validate users' acceptance for many different types of technologies including instant messaging and Internet usage (Yaobin, Tao and Bin, 2008; Porter and Donthu, 2006) and in different fields including health care (Wu and Kuo 2008), adoption of e-government (Horst, Kuttschreuter and Gutteling, 2007) and education (Teo, Wong and Sing, 2008).

One of the assumptions TAM operates upon is that when the user forms the intention to act, they will be free to do so without any limitations. In practice, limitations such as ability, time, environmental and organizational limits or unconscious habits will limit the ability of the individual to act.

Extensive research has been done on the external factors that influence technology adoption. The external factors that influence the acceptance, use and adoption of technology according to TAM include:

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(Porter and Donthu, 2006; Yaobin *et al*, 2008; Horst, Kuttischreuter and Gutteling, 2007; Wu and Kuo, 2008; Teo, 2009)

- Individual traits e.g. age, race, ability to concentrate, income, personal experience, self enjoyment and perceived enjoyment;
- Social traits e.g. culture, social pressure, subjective norms of others technology, social identity and trust in other people or systems;
- Educational level e.g. education, computer literacy skills;
- Work environment e.g. management support, technology complexity and facilitating conditions.

Chau and Hu (2002) found that TAM did not support key components when investigating acceptance of Telemedicine among physicians. They came to the conclusion that health care workers may have fundamental differences from other types of users when making decisions about technology acceptance. These findings were supported by Dixon and Stewart (2000) and Chismar and Wiley-Patton (2003) who similarly found TAM to be poorly linked to usage of Telemedicine by health care workers. Tulu, Horan and Burkhard (2005) explained in their study that health care workers have distinct characteristics when they make use of technology. These include being highly time-constraint and dealing with vital information. These characteristics make them a challenging user group to accept new technology. In another study Hu, Chau, Sheng and Tam (1999) found that although TAM was able to predict whether health care workers would use Telemedicine technology, a low statistical score indicated that there were some limitations to the model and that additional factors should be incorporated into TAM.

1.6.2 Unified Theory of Acceptance and Use of Technology

Unified Theory of Acceptance and Use of Technology (UTAUT) explains user intentions to use Information Systems and subsequent usage behaviour. The four key constructs that directly influence the usage intention and behaviour are *performance expectancy*, *effort expectancy*, *social influence* and *facilitating conditions*. Aspects such as gender, age, experience and voluntariness directly impact on the key constructs on usage intention and behaviour (Venkatesh, Morris, Davis, Davis, 2003).

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The UTAUT was developed through a consolidation of eight different models including the TAM and Diffusion of Innovation (DOI) models mentioned earlier. The theory itself was validated in a longitudinal study which explained 70% of technology acceptance behaviour in health care workers, a considerable improvement on previous models which routinely explain only 40% of acceptance (Venkatesh *et al*, 2003). The following table depicts the different direct and indirect constructs that have been identified in the literature by various authors that contribute to user acceptance, use and adoption of technology.

Table 3: External Factors Affecting Acceptance, Use and Adoption (Xazela, 2009)

	Anand arajan <i>et. al</i> , 2002	Porter and Donthu, 2006	Yaobin <i>et al</i> , 2008	Horst <i>et al</i> , 2007	Wu <i>et al</i> , 2008	Park, Lee and Cheong, 2007	Teo, 2009
Age	X						
Education		X					
Income		X					
Race		X					
Culture			X				
Concentration			X				
Social Pressure	X						
Personal Experiences				X			
Computer Skills	X						
Management Support					X		
Subjective Norm (SN)			X		X	X	
Social Identity (SI)						X	

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Trust				X	X		
Self Identity						X	
Technology Complexity (TC)							X
Facilitating conditions (FC)							X
Perceived Enjoyment (PE)	X						
Flow			X				

The next table is used to provide factors identified in the literature as important to continued use of technology. These factors are listed and the frequency of each as identified in literature by various researchers is displayed.

Table 4: Factors Affecting Continued IT Usage (Xazela, 2009)

	Wu <i>et al</i> , 2008	Mahmood <i>et al</i> , 2001	Lee, Lee and Lee, 2001	Anandarajan <i>et. al</i> , 2002
Past Usage	X			
Habitual Usage	X			
Positive Attitude		X		
Subjective Norm	X		X	
Highest educational level obtained		X		
Professional Level Skill		X		

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Level		X		X
Training Level		X		
IT Maturity Level		X		
Strategic Applications Level		X		
Organizational Support /factor		X		
Organizational size		X		

1.7 RESEARCH DESIGN

This research project refers to the TAM and the UTAUT. The TAM is used to depict the *perceived usefulness* and *perceived ease of use* that will ultimately determine the user's intention to make use of new technology and can therefore be used to predict and validate the factors that will influence technology adoption, acceptance and use (Teo, 2009). The UTAUT explains user intentions to use Information Systems and subsequent usage behaviour (Venkatesh *et al*, 2003).

Any research will have an underlying research paradigm that guides how the research should be conducted (Collis and Hussey, 2009). From the philosophical assumptions underlying the paradigms several different paradigms can be distinguished. Figure 2 is used to illustrate this paradigm.

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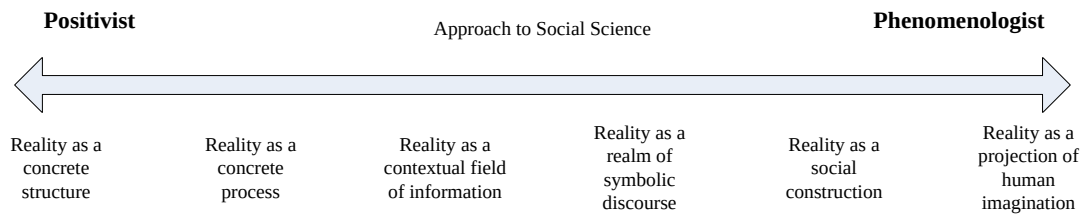


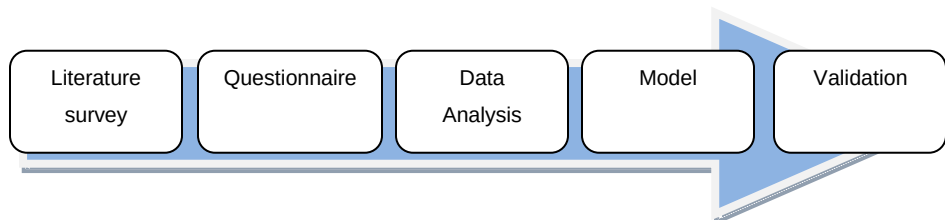
Figure 2: Typology of assumptions on a continuum of paradigms (Collis and Hussey, 2009)

Collis and Hussey (2009) argue that few researchers will make use of purely a Positivist or Phenomenologist (Interpretivist) approach within their research. By using a combination of the elements, researchers can take on a broader and often complementary view of the research problem or issue.

This research project will focus on the predicted acceptance and sustained use of technology making use of Telemedicine. This study will lean considerably toward a positivistic approach which is strongly linked to quantitative data collection, and is characterised as repeatable and objective. The approach will be based on inductive reasoning. In this case, the researcher begins with specific observations, or formulated research questions, from which patterns are identified. This leads to general conclusions or theories. For this research these conclusions will be recommendations based on Critical Success Factors for the successful acceptance of Telemedicine and the continued use after introduction.

1.8 RESEARCH METHODOLOGY

This study investigates technology acceptance and use of Telemedicine by health care workers in the Eastern Cape. The methodology applied is a quantitative research approach and the data collection method will be questionnaires. The research process that has been applied during this research study is shown in Figure 3.



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Figure 3: Research Methods

The research method can be classified as Positivism with the underlying assumption that the methods used to study the physical world can also be applied with modifications to the social world. The second principle of Positivism is that there is a single objective reality irrespective of individual values, attitudes or perspectives. Furthermore Positivism takes the form of general laws that express empirical regularities and relationships and therefore argues that experience is the only sound basis for knowledge. It is therefore an inductive scientific method (Sim and Wright, 2000).

Based on the formulation of the background to the study, the problem statement, objectives and research questions and the importance and benefits of this study emerged.

1.8.1 Data Collection Method

Questionnaires will be used to quantify data. The validity of the questionnaires will be evaluated by experts in questionnaire design before it is distributed. The questionnaires will be distributed via e-mail to participants and hard copy questionnaires will be delivered to those who do not have access to e-mail. Different formats of questions and responses will be used; yes/no, degree of agreement or disagreement (Likert scale), scale questions and rank order questions.

Published research will be used to construct the questionnaires according to the themes required. The TAM (Davis, 1989) will be used to construct *perceived ease of use* and *perceived usefulness* while Anandarajan, Igbaria and Anakwe (2002) will be adopted for the questions regarding organisational support and previous exposure to Information Technology.

1.8.2 Sample and Population

The study population will be selected at sites where Telemedicine has been introduced in the past 5 years in the Eastern Cape. The study will be conducted on a minimum of 75 health care workers including different disciplines e.g. medical practitioners, nurses and clinical support staff. The sampling method will be convenience sampling making use of the readily available study population. The questionnaire will be pre-tested using a pilot group of health care workers with similar characteristics to the research candidates.

1.8.3 Data Analysis Method

Data will be analysed using SPSS. Both illustrative and descriptive statistics will be used to analyse data. The independent nonparametric Chi-square test will be used to test the

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responses believe from health care workers as independent of age, gender education etc. Validity and reliability of the data will be ensured making use of a pilot study and data cleaning methods.

1.9 DELIMITATION OF THE STUDY

The study will be conducted at 6 hospital and 25 clinic sites situated in the Eastern Cape where Telemedicine has been introduced in the last 5 years. The study will investigate user acceptance and continued use of Telemedicine. A minimum of 75 health care workers from a multidisciplinary team will participate in the study. The study will make use of a questionnaire that will be sent via e-mail and hand delivered to areas not connected to the Internet. Exclusion criteria for this study include technology issues associated with Telemedicine as well as budget and other financial constraints faced by the implementers of the technology. Telemedicine used in the private sector will also not be included in the study. Inclusion criteria include Telemedicine used for clinical practices as well as training in the public health sector. Included in the training will be the issue of computer literacy of the participants of the study.

1.10 ETHICAL CONSIDERATIONS

Sim and Wright (2000) state that a researcher conducting research in health care should consider the following factors relating to ethics: informed consent; privacy and confidentiality; anonymity; deception; risk of harm; and, exploitation of respondents. The researcher is aware of the above ethical considerations, and will endeavor to conduct the research without malice or prejudice to either the respondents or the setting in which they work.

1.11 OUTLINE OF PROPOSED CHAPTERS

Chapter one will cover the background, problem statement, research questions and research methodology. In chapter two the availability and use of Telemedicine and IT usage in the Eastern Cape Department of Health will be examined. This chapter will provide an insight into the context e.g. history and benefits associated with Telemedicine in specifically developing countries.

Chapter three will focus on the adoption of Telemedicine within South Africa with specific reference to the Eastern Cape. The chapter will cover specific barriers and problems identified in the past with regard to Telemedicine projects as well as the continued use and sustainability

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of Telemedicine in the province. Chapter four will examine models and theories in technology adoption while continuing to make use of available literature.

Chapter five will focus on research design and methodology. A detailed explanation of how the study will be conducted and the tools that will be used will be discussed.

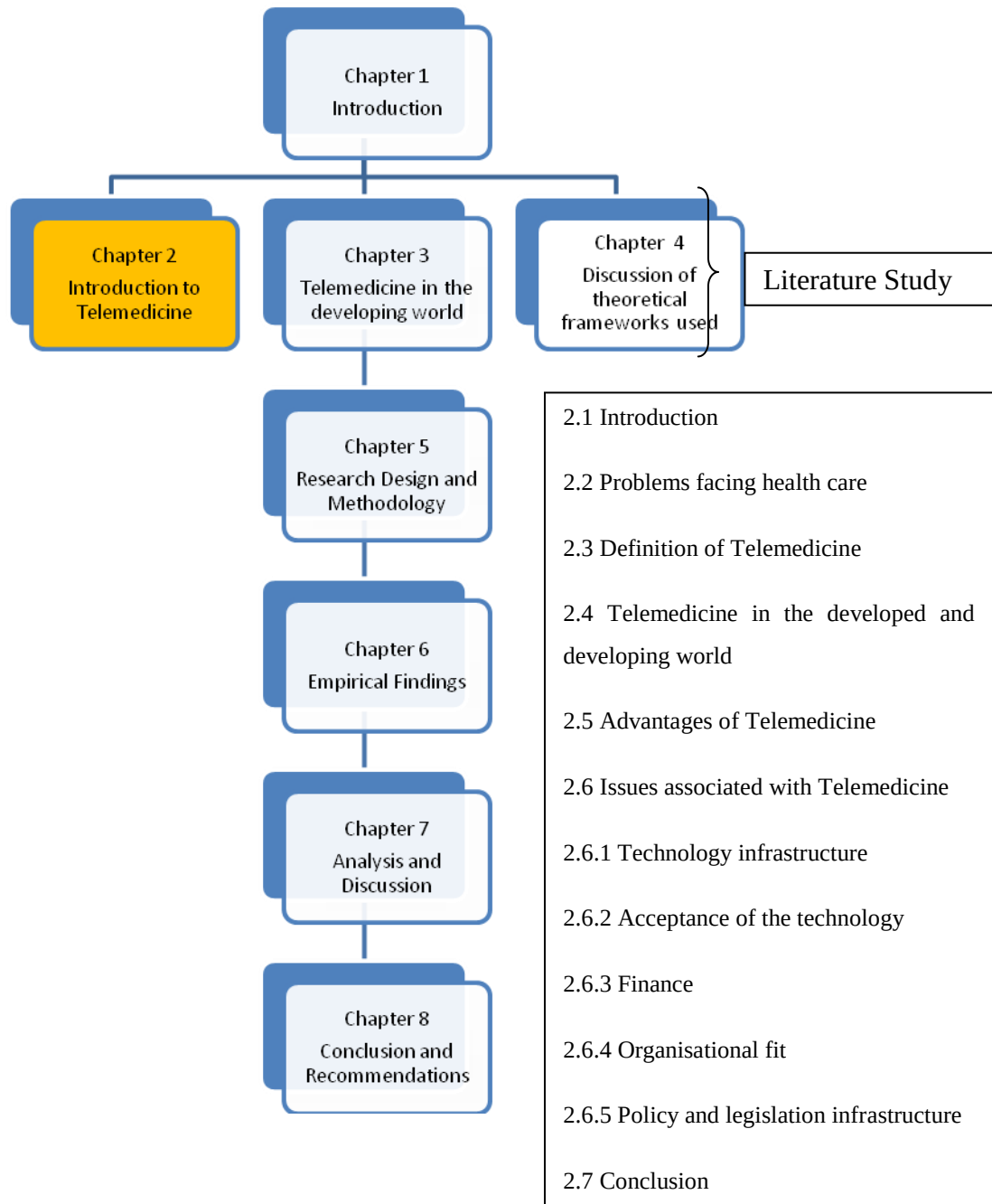
Chapter six will provide the findings of the study and recommendations will be discussed. Chapter seven will provide the conclusion based on the research findings and suggest any future research possibilities.

1.12 SUMMARY

This chapter provided an introduction and brief overview of the research study. It described the main as well as the sub research questions and discussed the importance of each to the outcome of the study. The challenges associated with health care in the developing world and specifically South Africa was highlighted and Telemedicine was introduced as a possible solution for these challenges. The theoretical framework that will be used in this study was briefly discussed and the relevance of the TAM and UTAUT models was illustrated making use of various examples from literature. Furthermore, the research methodology and design were discussed as well as the ethical considerations and delimitation of the study. The chapter then concluded with a brief outline of the chapters to come and the information that will be found in each. The next chapter provides an introduction to Telemedicine in general making use of existing literature published in various journals and books.

Chapter 2

Introduction to Telemedicine



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2.1 INTRODUCTION

Chapter 1 provided a broad overview of Telemedicine as well as the research question and objectives that this research project addresses. Literature provides many examples of the problems and obstacles that health care in Africa must overcome. These include health care worker recruitment and retainment, the HIV/AIDS burden, inadequate and inaccessible health care services and the isolation of health care workers in rural areas (WHO, 2002). The WHO has recommended Telemedicine as a tool to start to address some of these problems. While the early development of Telemedicine was focused on the geographical distance between patient and health care workers the latest development in this technology allows for a multitude of applications. These include rapid transmission of laboratory results via cellular phones, monitoring of the patient at home, electronic health records and even tele-surgery.

Telemedicine applications in the developed and developing world differ greatly. In the developed world the technology is used to deliver health care to the home while in developing countries the main aim of Telemedicine is to link isolated or understaffed health centres to urban referral hospitals.

The advantages of Telemedicine are well documented in literature both for clinical and educational use. The problems associated with Telemedicine have been the focus of many research projects and can broadly be divided into technology infrastructure; acceptance of the technology; finance; organisational fit of the technology and the policy and legislation framework within which Telemedicine operates. The chapter addresses the health care problems in Africa, provides an introduction to Telemedicine and concludes with some of the issues that is associated with Telemedicine. The next section provides an overview of the problems facing health care in Africa as well as the opportunities that Telemedicine presents in addressing these problems.

2.2 PROBLEMS FACING HEALTH CARE IN AFRICA

Sub-Saharan Africa has the lowest health care worker density in the world while it has to provide health care for an ever growing disease burden. It is estimated that 1.3% of the world's health care workers are employed in Africa, while 25% of the global disease burden occurs on the continent (Kifle, Mbarika, Okoli, Tsuma, Wilkerson and Tan, 2008).

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The burden of disease on health care services refers to the health care transition in developing countries from communicable diseases such as malaria, TB and HIV/AIDS to a degenerative or chronic disease profile as the population ages. This transition becomes a double burden on health care services in developing countries as provision must be made for both disease profiles (Norman, Bradshaw, Schneider, Pieterse and Groenewald, 2006). Furthermore the impact of this burden of disease mainly occurs in the productive mid-life period of the population and therefore affects the productivity and economic development of the workforce which contributes to the cycle of poverty (Ghaffar, Reddy and Singhi, 2006).

The WHO has found a positive association between the health care worker density in a country and the infant, under-five and maternal mortality rate. These rates are used internationally to compare the effectiveness of a country's health care system. The WHO therefore set the standard of a minimum doctor density per country of 20 doctors per 100 000 population. In Africa this average is 8.3 per 100 000 population (Martineau, Decker and Bundred, 2002).

Adding to the above situation is the HIV/AIDS epidemic which in South Africa has become the leading cause of death (Norman *et al*, 2006). Both Martineau *et al* (2002) and the Commission on Macroeconomics and Health (2001) reported that the epidemic has increased the health care workload due to the higher volume of patient care that must be provided and secondly the death and illness of the health care workers themselves.

In developing countries public health care problems include inadequacy and inaccessibility of health facilities for the poor and the loss of health care professionals in the public health service (Aderibigbe, Shonubi, Odusan, Oloruntoba, Agbahowe and Siddique, 2006). Literature has established that health care sectors in developing countries are massively under-funded (Commission on Macroeconomics and Health, 2001). In the rural areas of these countries the lack of finances are reflected in the poor infrastructure and the lack of diagnostic equipment, medicines, transport and clean water in hospitals and clinics (Martineau *et al*, 2002).

Cullinan and Thom (2005) report that the distribution of health care workers in South Africa have always been highly inequitable. The highest concentration of health care workers can be found in the private sector, the richest provinces and urban areas. The private sector in South Africa employs half of the country's nurses and two-thirds of the doctors. This unequal distribution

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between the private and public sector and urban and rural areas contributes to poor service delivery in public health care (Medecins Sans Frontieres, 2007b).

The shortage of nurses in the public sector has grown substantially worse between 2000 and 2005. The continuous loss of health care workers means that the workload and stress on those remaining increases, causing the remaining workforce to leave as well (Medecins Sans Frontieres, 2007b). These problems lead to a workforce that is often demoralized and demotivated (Martineau *et al*, 2002).

The 'brain drain' of skilled health workers from poor countries to richer ones is a major cause of the health worker crisis in many developing countries. It is estimated that in Zambia, 550 of the 600 doctors trained since independence have left the country (Martineau *et al*, 2002). Problems cited as reasons why health care workers are leaving both the public sector or emigrating include a lack of public health finances and continuing education opportunities, fragmentation of services, a decline in salary levels and poor promotion prospects and working conditions (Martineau *et al*, 2002).

Literature has identified several other universal obstacles for health care in specifically the rural areas of developing countries. These include lack of staff and specialist support for staff in rural areas, lack of educational opportunities for health care workers and long distances that must be travelled by patients to access health care (Telemedicine, 2002).

2.3 DEFINITION OF TELEMEDICINE

In 2005 the World Health Assembly recommended the adoption of a resolution affirming member nations' commitment to E-health and specifically Telemedicine after the WHO identified Telemedicine as a possible solution to the growing problem of severe staff shortages of health care workers in developing countries (Jack and Mars, 2008).

E-health is an emerging field within the medical informatics, public health and business domains using the Internet and related technologies to deliver or improve health services and information (Eysenbach, 2001). The term 'E-health' has become an umbrella term for a variety of technologies associated with it. These include Health Informatics, Telemedicine, Consumer

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Health Informatics and E-business (Pagliari *et al*, 2005). This study focuses specifically on Telemedicine.

Telemedicine is defined by the World Health Organisation as “...the practice of medical care using interactive audiovisual and data communications including medical care delivery, diagnosis, consultation and treatment, as well as education and the transfer of medical data.” It can be used to strengthen and improve the quality and equity of health care services through means of e-learning, knowledge management, disease surveillance, response to epidemics and e-supported resource management (Nwabueze *et al*, 2009).

The early development of Telemedicine however was affected by the cost and technology limitations of the time. Technological advances such as fiber optics, compressed video and integrated service digital networks have decreased or completely eliminated many of the problems such as high costs, poor quality and poor access to the technology initially experienced. This has led to an increase in the technology both in the public and private sector providing opportunities to increase the quality of the technology and decrease the cost (Pinnow, 2001).

During the early development of Telemedicine the main focus was on geographical distance. The technology was found to provide a means of medical diagnosis for patients in remote areas or those that were unable to travel far distances. Only in later years did the cost reduction and inconvenience of travelling become more important factors in the development of Telemedicine (Lemma, 2004). Early examples of Telemedicine include a rudimentary system in 1922 whereby medical advice was dispensed to ill and injured sailors from the Sahlgrenska Hospital in Sweden via radio. The National Aeronautics and Space Administration (NASA) pioneered the early development of Telemedicine in the 1960s when scientists monitored the physiological functions of astronauts from earth (Lemma, 2004).

Remote consultation can be provided in a very simple way by making use of telephones or e-mail contacts between remotely located health professionals. More recently high end technology and sophisticated network communication such as video conferencing are also being used where available (Lemma, 2004). Presently Telemedicine is practised in one of two ways: Store and forward or a synchronous approach. In the first approach, patient data, images or sound

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files are transmitted via e-mail to a specialist who can review the information at a later stage and then send back a diagnosis and/or management plan. In synchronous or face-to-face Telemedicine the patient consultation occurs in real time using video-conferencing (Jack and Mars, 2008).

Telemedicine is not only being used for consultation purposes. It has been used in several studies for the rapid transmission of laboratory results via short message service (SMS) messages between health care providers and patients. The benefits of this would be to save patients' transportation costs to health care facilities in order to fetch results as well as decreasing overcrowding in public health care facilities (Heinzelman, Lugn and Kvedar, 2005). Other uses include e-mail consultations between health care professionals and patients, Virtual Reality (VR) enhanced telesurgery, robotics, enabling access to electronic health records and support for clinical practice, governance, research and policy (Heinzelman *et al*, 2005; Pagliari *et al*, 2005; Nwabueze *et al*, 2009; Kifle *et al*, 2008). Services that have been enhanced by Telemedicine include dermatology, oncology, primary health care, emergency care, physical rehabilitation (mentoring and supervision), surgery, pediatrics, psychology/psychiatry, radiology, pathology, ophthalmology and obstetrics (Whitten and Love, 2005; Cellar, Lovell and Basilakis, 2003; Dhillon and Forducey, 2006).

2.4 TELEMEDICINE IN THE DEVELOPING WORLD

The application of Telemedicine has expanded exponentially in the last few years as its benefits are being realised by governments worldwide. This can be directly attributed to the growing evidence that the technology is effective and efficient (Pagliari *et al*, 2005; Kifle *et al*, 2008).

In countries such as North America, Europe and Japan, Telemedicine has been in practice for the past 50 years. An early example is the Nebraska Psychiatric Institute that shared a closed circuit television link with Norfolk Hospital in 1959. This link was used by doctors to consult with each other on patient cases and also to provide psychiatric consultations to patients on the other end of the link. Since then the technology has advanced and now ranges from simple telephonic and e-mail consultations to sophisticated Virtual Reality (VR) enhanced telesurgery (Adler, 2000). Another recent development with Telemedicine in the developed world is to move health care from the hospital into the home which has become recognised as the best place to deliver health care. This mode of delivery allows the patient to actively participate in

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their own health care while reducing their hospital visits. Telemedicine can contribute to this via embedded sensors in the home that wirelessly transmit medical information to a personal computer and update a secure database controlled by the patient and accessed by their doctors (Adler, 2000).

Traditionally the developing world has had little success with Telemedicine. This can be attributed to the high costs associated with Internet connectivity, high-end videoconferencing systems and sophisticated medical devices. These expensive technologies cannot compete with the more immediate priorities (nutrition, sanitation and vaccinations) of the developing world (Adler, 2000). In addition the lowest level of ICT-related infrastructure in the world is found in Sub Saharan Africa (less than 1 phone line per 100 people), electric power supply instability and poor Internet connectivity beyond urban areas (Kifle *et al*, 2008). Due to the limited infrastructure the main application of Telemedicine in developing countries will continue to be as an application to link health centres, referral hospitals and tertiary centres (Heinzelman *et al*, 2005; Adler, 2000).

2.5 ADVANTAGES OF TELEMEDICINE

According the Sorenson (2010) Telemedicine can be used to provide clinical services; expert consultations; distance education; telemonitoring both in the hospital and at home; health information to the health care workers and the public as well as peer support. The potential of Telemedicine to improve health services is well documented. It can be used to expand access to and improve primary, secondary and tertiary care thereby increasing the efficiency of these services while decreasing cost. The benefit of the increased access to specifically specialist care means that the geographical variability of health care is reduced (Heinzelman *et al*, 2005). In the future the increasing shortages of health care workers will mean that semi-skilled community health workers with limited training will have to provide primary health services and refer patients if needed. The need for adequate communication among the primary, secondary and tertiary levels of care will become paramount in ensuring patients is referred timeously. Telemedicine can bridge this gap as supervision, medical expertise and educational opportunities can be provided by skilled health care workers to rural areas (Heinzelman *et al*, 2005).

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Some of the other proven benefits of Telemedicine include:

- *Increased quality of care* – increased access to specialized services with fewer unnecessary referrals to urban hospitals;
- *Saving time and cost* – both for the patient travelling to specialized services and health care workers attending educational opportunities. It is also more cost efficient to make use of Telemedicine than to employ and retain specialists in rural areas;
- *Decreased isolation of health care workers* – new skills can be acquired, support networks built, supervision and mentoring in rural areas provided;
- *Education and training opportunities* - health care workers can upgrade their professional knowledge, improved access to information for health care workers, patients and the population in general.

(Strachan, 2001; Lemma, 2004; Hjelm, 2005; Watson and Gasser, 2005; Medical Research Council, 2004).

Education can be provided in various forms including continuing distance education, community health education for the public such as hygiene and family planning as well as medical information exchange between health care workers (Lemma, 2004). The advantages of education apply to both health care workers in the rural and urban areas. Many teaching hospitals in the developed world have reported a redistribution of skills as they can use the case studies at developing world hospitals to teach students about pathologies they may never encounter in their own countries. In the same way the health care workers in rural areas are supported and provided with new skills making use of Telemedicine as the teaching medium (Heinzelman *et al*, 2005).

2.6 ISSUES ASSOCIATED WITH TELEMEDICINE

In the past the emphasis of health care and ICT research was on the infrastructure problems experienced by service providers and health care workers. The emphasis has now changed to how the technology is being used to facilitate communication and decision making including the human and organizational factors involved (Pagliari *et al*, 2005). Chetty (2005) found that there are several obstacles to the effective implementation of Telemedicine. These include infrastructure and human or cultural factors including training and legislation. Similarly Crump, Kumar, Orsak and Pfeil (1998) reported that the success of Telemedicine is largely determined

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by user acceptance issues and cost. According to literature the main categories that will determine the future implementation of Telemedicine projects are: (1) Technology, (2) Acceptance, (3) Financing, (4) Organization and (5) Policy and Legislation (Broens, Vollenbroek-Hutten, Hermens, van Halteren and Nieuwenhuis, 2007).

2.6.1 Technology Infrastructure

Many potential telemedicine projects have been hampered by the lack of appropriate telecommunications technology. However, private telecommunications companies and technology manufacturers are willing to produce the low-cost equipment and bandwidth for Telemedicine to promote the industry to become self-sustaining and profitable (Sing, 2003).

Telemedicine equipment is not as reliable as health care workers demand (Cellar *et al*, 2003). Jack and Mars (2008) recommend that some of the requirements of the technology used for telemedicine should be that it is reliable, of sufficient quality, correctly calibrated and should not fail or compromise patient safety. In a study conducted by Careau, Vincent and Noreau (2008), Telemedicine was found to be an effective tool to plan patient care in a multidisciplinary team. They reported 2% of trouble shooting time attributed to poor audio quality. The recommendation was to use the correct equipment and appropriate training of users before making use of the technology. The main limitation of this study however was that it was conducted in a technology friendly environment and only a small amount of video conferencing opportunities were analysed during the study. Similar problems were reported by Styles (2008) in a study where Speech and Audiology therapists were conducting video conferencing sessions. Here 16% of the participants reported communication difficulties because of technical problems. Cellar *et al* (2003) also reported that half of the participants had transmission glitches during their study. They also argued that for Telemedicine to be adopted beyond a pilot phase it would have to be glitch free in practice.

2.6.2 Acceptance of the Technology

Patient acceptance and satisfaction has been found to be consistently high in various studies conducted. Reported reasons for this include easier access to specialists, reduced travel, shorter waiting times for appointments, improved effectiveness, financial savings, a wider interaction system, accurate diagnoses, personalized care, and the ability to address cultural issues (Whitten and Love, 2005). In contrast, Telemedicine is slowly being adopted into clinical practice, but with some resistance (Heinzelman *et al*, 2005). This is partly due to the benefits of

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Telemedicine being widely reported, but very little outcome based research available to support the claims of increased efficiency and effectiveness (Yarbrough and Smith, 2007; Berger and Kichak, 2004). Heinzelman *et al* (2005), Garshnek and Hassell (1999) as well as Sorensom (2010) found that this is because the research designed to investigate the effectiveness and efficiency of Telemedicine is based on intuition and not empirical evidence. Garshnek and Hassell (1999) found that most of the research conducted did not employ rigorous comparative studies to assess quality, cost, access to health care and patient/provider satisfaction. Even the few studies that were conducted scientifically may no longer be relevant as they were based on older technology. Another disadvantage of previous research was that it focused almost exclusively on pilot/demonstration projects funded by donors incorporating expensive interactive video telecommunications. During the research period the technology was deemed a success; however the systems failed once the donor funding was withdrawn. The challenge then is to provide Telemedicine solutions that are self sustaining, simple, transparent and flexible enough to meet the unique needs of the health care system (Garshnek and Hassell, 1999). Part of the problem with the validity and reliability of research conducted in this area are the untested instruments used to collect data. Ways to measure user acceptance must be standardized in order to draw generalised conclusions about Telemedicine. Reliable and valid instruments needs to be developed and rigorously tested for quantitative studies in order to measure consistently what the researchers are attempting to measure. Terminology must be defined when making use of survey instruments and the construct process must take into consideration all the different elements and factors useful when measuring technology acceptance (Whitten and Love, 2005). Telemedicine also increases the expectation of the patients as more interventions and services become available. However the cost of these technologies often increases the gap between what is possible and what the patient can afford (Garshnek and Hassell, 1999).

Various studies have found that user acceptance of new technology can be a limitation to successful implementation. Health care workers in developing countries often believe that Telemedicine is not appropriate to their setting because of poor ICT infrastructure in the country itself and the low level of computerization in hospitals (Lemma, 2004).

Chismar and Wiley-Patton (2003) reported that health care workers have not fully embraced ICT or the resources it can provide to health care. This is supported by Fitzgerald, Aitken and

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Krauss (2003) and Pagliari *et al* (2005) who both found that user acceptance of Telemedicine was a risk to the successful implementation of the technology. The Lewin Group (2000) went further and suggested in their report that user acceptance of health care workers was the second biggest threat after the availability of appropriate technology to the successful implementation of Telemedicine. Hjelm (2005) found various different human and cultural factors associated with the user acceptance of Telemedicine. These factors include the perceived threat to the role and status of health care workers; fear that Telemedicine will increase the workload of health care workers; fear of being obsolete if technology advances and cultural differences. This is supported by Whitten and Love (2005) who also reported that although most studies have provided support for Telemedicine by health care workers, some concerns were still raised. These include being able to help patients in emergency situations, the high cost of the technology as well as the ability of the technology to handle high demand, potential for extra work and the need for training.

Doctors in charge of health facilities in rural areas may perceive Telemedicine as an intrusion by 'outside specialists' into their domain, which may lead to resistance in using the technology (Baigiire and Godes, 2003). Lemma (2004) reports that typical reasons given by doctors as to why they do not make use of Telemedicine are that they are too busy or have a personal policy against the use of ICT in medical care.

The opinion of and support for Telemedicine from management within the health care facility can also influence the health care workers' acceptance of the technology. Supervisors who fail to understand the application and benefits of Telemedicine can actively block the successful adoption of the technology (Whitten and Love, 2005).

Jennett, Yeo, Scott, Hebert and Teo, (2005) found that the initial limited application of Telemedicine on first introduction into the health care system is a barrier to user acceptance from health care workers. The study found that the expansion of Telemedicine to include more specialties was a requirement from users in order to accept it.

Diagnostic confidence is an essential condition for the use and further development of Telemedicine as a doctor must diagnose a patient without a personal physical examination which can increase the chance of misdiagnoses when making use of Telemedicine (Lemma, 2004). The probability of erroneous diagnoses cannot exceed the error of traditional procedures

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if Telemedicine hopes to be accepted by health care workers. Diagnostic quality between Telemedicine and traditional services has been compared for dermatology (Jøsendal, Fosse, Andersen, Stenvold and Falk, 1991), pathology (Eide and Nordrum, 1994) and endoscopy (Pedersen, Hartviksen and Haga, 1994). All of these studies verified that Telemedicine based diagnostics maintained a high professional standard (Holand and Pedersen, 2005). Another possible barrier when introducing new technology into an established routine is resistance to change. Health care workers may resist these changes as they may construe that there is something wrong with the existing level of care while they often feel that they are providing the best care possible (Whitten and Love, 2005).

Dansky, Gam, Vasey and Barsukiewicz (1999) also found that the value a doctor places on the close patient relationship to be a negative predictor for the acceptance of technology. System-specific issues that were cited in literature include the reliability and dependency of doctors with adopting new technology (McAlearney, Schweikhart, and Medow 2004). Stanberry (2001) warns health care workers against excessive reliance on technology if this meant that the traditional clinician-patient relationship suffers. He goes on to say that the comfort and compassion found in face to face consultations is lost when using Telemedicine. Stanberry (2001) further argues that many risks and responsibilities when using distant medical intervention and consultation are not yet known.

It should however not be assumed that the use of Telemedicine will automatically lead to a breakdown in patient-doctor relationships. Hjelm (2005) argues that it is not the technology that will lead to this breakdown, but rather poor communicative skills and a lack of formal training in using the equipment. Other factors according to Hjelm (2005) that can contribute to this breakdown include depersonalization, the different processes of consultation including inability to perform the whole consultation and health care workers not introducing themselves to the patients, reduced confidence of health care workers in the technology because of a lack of empirical research and the different knowledge and skills required by health care workers when using the technology.

2.6.3 Finance

Developed countries spend on average 2-2,5% of their health care budget on ICT. This translates to \$55 spent per person in the United States of America. In comparison, Africa will spend \$0,75 per person of the health care budget on ICT. The economic evaluation of

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Telemedicine is not a priority and seldom found in projects. Reasons given for this include the complexity of e-Health, the variety of stakeholders that value different outcomes, inappropriate evaluation methods and the difficulty measuring health benefits achieved through using Telemedicine (Mars, 2010). The cost of installation of the hardware and infrastructure of Telemedicine is one of the greatest barriers to overcome. One way of achieving this would be to divide the installation into phases as once the technology is operational, the maintenance cost is low (Sing, 2003).

Health care technology provides both a microeconomic and macroeconomic impact on health care. At the microeconomic level the cost of the technology can be calculated making use of formal cost accounting such as price and charges. The impact of the technology itself can be measured making use of comparisons of resource requirements and the outcomes/benefits of the technology such as cost-minimization analysis, cost-effectiveness analysis and cost-benefit analysis. The macroeconomic impact is defined as the impact the technology will have on national health care costs and the effect of technology on resource allocation among different health programs or other sectors of the economy (Mars, 2010).

Some of the most commonly used types of economic impact of Telemedicine applications include costs associated with patient time and productivity, transportation, utilization of health care services and productivity of health care workers. The introduction of Telemedicine will then prompt various cost tradeoffs when introduced for the first time. The shorter term costs of Telemedicine, in particular the start up cost of installation, are often over estimated as it is often determined based on per-patient costs where traditionally patient utilization is low for start-up programs. Other problems include the fast changing cost structures of rapidly evolving technology, complex cost accounting structures if the technology is shared between different serves, departments or institutions and the establishment of Telemedicine may lead to expanded or unanticipated applications (Lewin Group, 2000).

Cellar *et al* (2003) however point out that although the technology should not be judged on its cost alone, it cannot be ignored either. They reviewed 175 articles that studied chronic disease management making use of Telemedicine, and found only 4 that considered cost effectiveness. McAlearney *et al* (2004) noted that most studies conducted are sponsored by external stakeholders and not by government. This would explain why cost is not identified as a barrier in recent literature. Mars (2010) added other problems such as limited data available, small

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sample sizes, poor evaluation tools, the length of time to the breakeven point (3-13 years) and the fast pace at which technology and its associated costs change. He suggested that emphasis must be put on the non-financial benefits of the technology as it cannot be equated with the traditional profitability margins used in the private sector. Further suggestions included that a special interest group be set up to investigate, research and develop these economic tools. This group should consist of different universities and other stakeholders such as the World Health Organisation. Difficulty exists when attempting to evaluate clinical applications of Telemedicine. These include the rapid advancement of information and telecommunication technologies; a complex and non user-friendly technical infrastructure; diverse telemedicine technologies and the unusual level of cooperation that Telemedicine demands of independent institutions and individuals (Field, 1996). Field (1996) further suggests a framework to evaluate Telemedicine consisting of 4 basic components – basic principles, a careful planning process, key evaluation elements and fundamental evaluation questions. These principles guide the framework to be:

- Included from the start in the program design, implementation and design;
- Viewed as a cumulative and integrated tool for decision making rather than an isolated research exercise;
- Comparable to current practices in order to compare benefits and costs of Telemedicine;
- Focused on identifying practical and economical ways to achieve the desired results rather than investigating singular Telemedicine options.

2.6.4 Organisational Fit

Health care workers resist Telemedicine due to the interruption of traditional practice patterns according to Yarbrough and Smith (2007). Horsley and Forster (2005) report that the major barriers for physicians to accept new technology are cost and time. The additional time that must be spent operating the new technology is singled out as the biggest culprit as some studies found that certain Information Systems would require more time to operate than the more traditional paper based methods (Overhage, Perkins, Tierney and McDonald, 2001). According to the literature, larger practices are also more than 50% more likely to have access to Telemedicine systems (Audet, Doty, Peugh, Shamasdin, Zapert and Schoenbaum, 2004).

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Poor quality of imaging can limit the usefulness and perceived effectiveness of Telemedicine. The initial amount of time required to set up the technology and adapt to it is also a barrier to user acceptance (Whitten and Love, 2005). Jack and Mars (2008) found that technical guidelines and standards for radiology, dermatology and psychiatry are available in developed countries, but are not achievable in resource limited developing countries. Instead they argued that guidelines specific to developing countries are needed to set minimum image standards for different areas of practice including shortcomings associated with reduced image resolution. Other organisational problems include the lack of access to the system, time constraints during the working day and restricted access to the equipment because it needs to be physically secured at all times (Polaha, 2005; Baigiire and Godes, 2003).

2.6.5 Policy and Legislation Infrastructure

The Minister of Health, Dr. Motsoaledi, (2010) suggested that legislation regarding Telemedicine must be prioritised in future. Issues such as a code of ethics, regulation and the use of Telemedicine in health technology across borders must be addressed as a matter of urgency. This is important as the patient is not in a face-to-face contact situation with the treating health care worker and may never have any communication with the specialist responsible for the diagnosis or treatment plan. This raises serious issues about informed consent, confidentiality, data security and medical responsibility. The issue of informed consent becomes more complex if the patient has had limited exposure to and knowledge of ICT. The explanation of the technology used in Telemedicine remains technically complex even if both the health care worker and patient are computer literate. In the South African context, with 11 official languages and diverse cultures, this may put added pressure on the patient-doctor relationship which is already limited due to language barriers (Jack and Mars, 2008). Linghamp (2010) states that there is currently no formal legislation regarding Telemedicine in place in South Africa. The National Department of Health drafted an amendment to the Health Act in 2008 but has since scrapped this and restarted the process. The Health Professional Council of South Africa drafted Telemedicine guidelines in 2008 but has not formally adopted these guidelines. The Telecommunications Act is currently the only legislation available to guide Telemedicine in South Africa. Currently the International Convention for Telemedicine, which will provide laws for services rendered across international boundaries, is being drafted and will be submitted to the World Health Assembly in 2011 for adoption.

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Patient litigation, privacy/confidentiality, misinformation and the lack of regulations to deal with such issues serve as a barrier to health care workers adopting Telemedicine (Kassirer, 2000, Cellar *et al*, 2003). This is supported by Cellar *et al* (2003) who argue that Telemedicine also brings with it many medico-legal issues related to malpractice, licensure boundaries, documentation and the security of information transfer. It has been noted that Telemedicine is vulnerable to security breaches due to telecommunication linkages. It is thus important that a confidentiality policy should be in place and be enforced by all staff involved with Telemedicine. The role of these policies or standards must be considered with all the different stakeholders in mind and must be suitable to the health care setting it is being used in (Kifle *et al*, 2008). All health care organisations need to have strict measures in place to protect the confidentiality, integrity, auditability and availability of the health information entrusted to them. IT security management in health care has become even more important and complex by increasing the use of wireless and Internet technologies. Clear, concise and health care specific guidance on the selection and implementation of controls must be available and more importantly adaptable to a wide range of sizes, locations and models of service delivery in health care. An example of such a technical guideline is the ISO/IEC 27021 which provides guidance to healthcare organizations and other custodians of personal health information on how best to protect the confidentiality, integrity and availability of information being sent via Telemedicine.

The standard has been adopted by IT security managements in South Africa, Canada, Australia, France and the UK (ISO, 2008).

Special consideration which must be taken when designing operational guidelines for Telemedicine in that the health care delivered is able to cross jurisdictional borders and take place on a plane or ship situated beyond any national jurisdiction. Examples of this are consultations with specialists in other countries or international team involved in disaster relief. For this reason countries must prepare policy on the precautions to take when using Telemedicine as well as to make sure that it is applied by health care workers (ISO, 2008).

Reimbursement for services rendered via Telemedicine is still a huge challenge in most countries. Recent advances in developed countries have seen Telemedicine services being paid for as long as the area being served is considered a “provider shortage area” (Cellar *et al*, 2003). In this area Teleradiology seems to be the most common application that can be

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reimbursed as radiology consultations can be provided without the face-to-face relationship required for most other consultations (Field, 1996).

Security and confidentiality of a patient's information raises ethical and medico-legal issues. Some patients may not be willing to have parts of their body exposed to ICT equipment and must have the option of being treated with a traditional face-to-face consultation if so preferred. The verification of which doctor treated a patient may be difficult to trace when consultations are provided from a distance as there will be no signature on the patient's medical records (Lemma, 2004). Whitten and Love (2005) identified that patients had concerns regarding privacy and the potential lack of a relationship with a provider. Nurses conducting a physical examination on behalf of specialists were also identified as a concern as important pathology might be missed by an inexperienced examiner. This also raises the question of who is responsible for the patients' management if being treated via Telemedicine (Lemma, 2004). It may be reasonable to expect both the referring health care worker and specialist consulted to keep adequate records of all aspects of the telemedicine consultation, but the matter of responsibility for the prescription of drugs and electronic signatures requires further legislation (Jack and Mars, 2008). The network being used may not be secure and could result in patients' confidential material being lost if a virus or hacker attacks the system (Lemma, 2004).

The main areas of concern that must be addressed before Telemedicine can be considered successful and fully integrated into mainstream health care can be summarised as Technology Infrastructure; Acceptance of the technology, Finance, Organisation Fit and the Policy and Legislation Infrastructure. Table 3 provides an oversight of some of these areas as the information presented in section 5 is summarized.

The Infrastructure problems can be categorised as the external environment including water and electricity and the quality or robustness of the equipment. Other important technology issues for health care workers include the diagnostic quality of the system as the patient cannot be examined physically by the consulting doctor. The technology therefore must be reliable and technical guidelines must be available for the development and production of Telemedicine equipment. The physical security of the equipment was raised by a few authors as very important as the financial impact of the technology is considerable. At the same time there must be a trade off between the security and accessibility of the technology. The cost of installing

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and maintaining a Telemedicine unit is also a concern as many of the studies reported in literature was conducted on pilot studies where donor funding was used to set up the initial system. This raises concerns about the sustainability of the technology once the initial pilot phase is over and donor funding is stopped.

The acceptance of the technology must be supported by management, health care workers and patients if it is to succeed. Obstacles for the health care workers themselves include fear of change to the established work routine and status quo. Outside intrusions by specialists which may cause additional work or decrease the status of the health care worker at rural health care facilities are perceptions that must be addressed before the technology is accepted and used optimally. The same is true for computer literacy and training to use the Telemedicine system. Low computer literacy and a lack of training to use the system must be addressed for the system to be used optimally.

Policy and Legislation infrastructure must be in place for health care workers to feel comfortable with the technology. Medico-legal issues such as privacy and confidentiality, informed consent, electronic signatures, responsibility of care and security of the data base and transmission must be addressed to avoid unnecessary exposure to litigation.

Table 3: Issues associated with Telemedicine identified in literature

	Chismar and Willey-Paton(2003)	Heinzelman et al (2005)	Cellar et al (2003)	Polaha (2005)	Hjelm (2005)	Lemna (2004)	Baglire and Godes (2003)	Whitten and Love (2005)	Jack and Mars (2008)
Infrastructure									
External environment								Water + electricity	Quality of equipment
Diagnostic quality			Reliability			Cannot examine the patient		Time	Reliability, Technical Guidelines

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								Gap between accessibility and affordability of treatment		
								Empirical research lacking: donor funded		
Accessibility			Security							
Cost			Funding							
Acceptance										
Threat to status			Specialists intrude on domain	Unwilling to use technology	Threat to status				Non Acceptance of technology	
Fear of increased workload		Extra duties			Increased workload				Interruption of traditional practices; Increase in time + cost	
Fear of being obsolete				Skills not recognized	Not being recognised					
Cultural differences			Support from community		Differences in culture					
Support from management		Acceptance of technology								
Patient acceptance				Resist new technology	Communication skills: doctor patient relationship					
Training										

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Lack of training			Need comprehensive training	Lack of ICT skills		No formal training			
Lack of ICT skills			Lack of ICT equipment	Low pc penetration	Staff become technicians				
Legislation									
Payment						Payment of services			
Informed consent, confidential	Understanding of technology	Privacy, lack of relationship with provider					Privacy issues		
Medico-legal issues	Electronic signatures	Responsibility of care		Misdiagnosis, electronic signatures			Litigation; malpractice		
Security				Physical security of system			Lack of regulation, security of data transfer		

Table 3 highlight the issues associated with Telemedicine. These issues can be summarised into 4 categories namely infrastructure; acceptance of the technology; training and legislation. Most of the issues are identified repeatedly in literature as the cause why Telemedicine fail when implemented in developing countries.

2.7 CONCLUSION

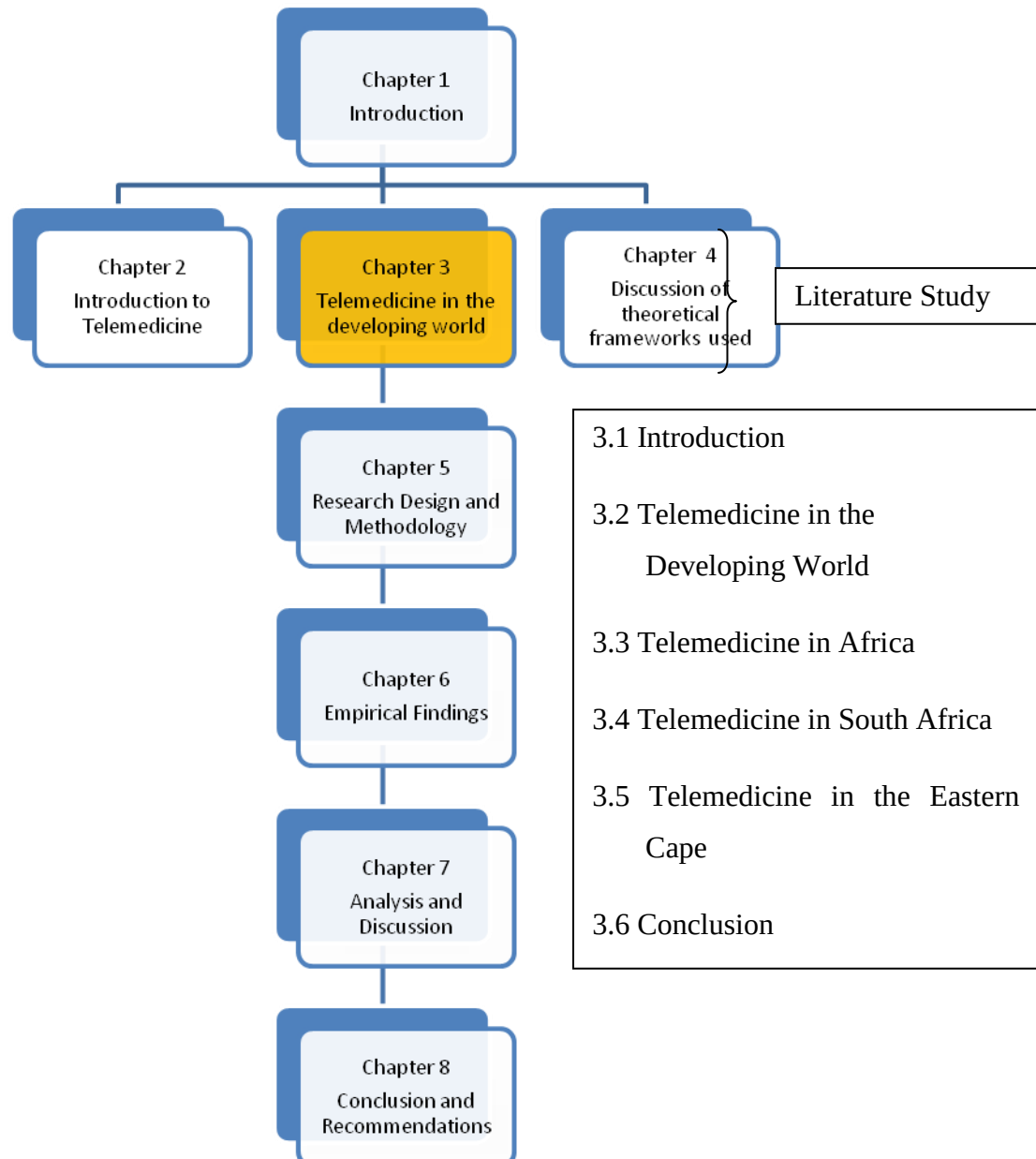
This chapter introduced Telemedicine as a suitable alternative to the health care problems identified in specifically developing countries. It has been recognised internationally by the WHO as a possible solution to address the inadequate number and distribution of health care workers in developing countries as well as a suitable training medium to encourage professional

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development. The application of Telemedicine has evolved since the first very elementary system and is currently being used in many different ways and forms e.g. SMS, telesurgery, electronic health records and home health care delivery. The advantages of Telemedicine are well documented that is an increase in the quality of care, saving time and cost, decreasing the isolation of health care workers and providing educational and training opportunities. There are however also well documented issues that must be addressed before Telemedicine is fully accepted and used in the health care sector. These include technology infrastructure, acceptance of the technology, finance, organisational fit including managerial support and training and the policy and legislation framework that must be in place. The next section will explore Telemedicine in developing countries with particular emphasis on South Africa and the Eastern Cape in particular.

Chapter 3

Telemedicine in the Developing World



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3.1 INTRODUCTION

The previous chapter discussed the problems that health care in specifically developing countries face. It further provided a definition of Telemedicine and explained the concept of Telemedicine as well as the advantages and disadvantages of the technology. This chapter explores Telemedicine in the developing world making specific reference to Africa and South Africa. Various projects in these countries are described along with the contribution it has made to the health care system in that particular country. The problems and issues surrounding Telemedicine are also discussed. Telemedicine in the Eastern Cape is also highlighted making use of relevant literature. It is important to be aware of these problems associated with Telemedicine as it will directly affect user acceptance and use of the technology by the end user. Some of the problems experienced with previous and existing Telemedicine are highlighted making use of examples in South Africa and especially the Eastern Cape. The next section discusses the use of Telemedicine in the developing world. Following this the chapters address Telemedicine in Africa, more specifically South Africa and finally concludes with a discussion of Telemedicine in the Eastern Cape.

3.2 TELEMEDICINE IN THE DEVELOPING WORLD

Telemedicine in developing countries is used mainly to link health centres, referral hospitals and tertiary centres. There are many examples of Telemedicine implemented with various degrees of success in these countries (Heinzelman *et al*, 2003, Adler, 2000). According to Craig and Patterson (2005) there are two reasons for making use of Telemedicine. The first is that there are no alternatives and the second is that Telemedicine has significant geographical advantages over traditional medicine. But despite high expectations for Telemedicine, the uptake of the technology into routine use has been slow (Kifle *et al*, 2008).

In India there are many Telemedicine programs operating making use of existing infrastructure as well as satellite and internet media. The World Bank has provided loans to India in order to improve the health care systems which include making optimal use of existing facilities in tertiary hospitals and strengthening of linkages with secondary care hospitals. Telemedicine must still be rolled out to the primary health centres and other rural areas but in order to do so the current health care programs must be integrated to improve funding as well as implementation and monitoring of these programs (Sing, 2003).

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The Norwegian Ministry of Foreign Affairs financed a Telemedicine project in Palestine linking four rehabilitation centres domestically to international rehabilitation centres. This was necessitated by the travel restrictions that patients and health care workers faced due to the increasing isolation of the region. The project will provide for consultation and educational opportunities for health care workers in Palestine (Sorenson, 2010).

In Hong Kong a tele-consultation program implemented for neurosurgeons allows the transfer of images from physicians at general hospitals to tertiary hospitals. The referring physician provides the relevant information telephonically to the attending neurosurgeon after which a recommendation regarding the care of the patient is provided again telephonically. With increased usage of the system health care workers provided invaluable information which led to improvements enabling the pilot program to become an industrial strength program (Chetty, 2005).

The Swinfen Charitable Trust has set up a Telemedicine site where health care professionals in developing countries can ask for advice from leading medical and surgical consultants via a low cost Telemedicine service free of charge. Health care workers can send clinical photos, patients' histories and any other available tests or radiographic material to the trust. A secure web-based message system is used and the median length of the specialist reply is currently 1,8 days. The Trust is being used by 58 countries in the developing world and is linked to 190 hospitals and 464 specialists who provide guidance and advice (Sorenstom, 2010).

The World Health Organisation and the United Nations launched the '3 by 5' initiative to help low- and middle-income countries provide treatment to HIV/AIDS infected patients in 2003. The aim of the service was to provide supportive supervision and clinical mentoring to health care workers in developing countries via a Telemedicine service. The Website includes interesting case studies as well as answers to commonly asked questions. Policy documentation, guidelines, supporting material on HIV/AIDS care in low resource settings and links to other important websites are all accessible from this site. In addition, health care workers can ask for second opinions from HIV/AIDS specialists on specific or complex patient cases. Countries that make use of this service include Algeria, Cambodia, Ethiopia, Kenya, Ghana and Venezuela (Sorenstom, 2010).

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HealthNet is a global computer-based communications network that was developed by the international organization Satelife. The aim of HealthNet is, through the use of satellite, telephone and Internet technology, to link health care workers in more than 150 countries worldwide. Applications of HealthNet include collaboration amongst physicians, data collection, access to medical libraries worldwide and collaborative research worldwide including a warning mechanism to counter disease outbreaks (Friedland, 2001). This is similar to the Australian Telemedicine project known as the HealthConnect initiative which was designed to improve the quality of information exchange between providers, reduce duplication of services and provide greater portability of health records (Cellar *et al*, 2003).

Telemedicine in developing countries is slowly being accepted by health care workers but must be flexible and cater to the local need. It cannot simply be imported by an external donor and expected to have a 'one fit for all' mould (Chetty, 2005). Sorenstom (2010) expanded on the above by adding the following challenges when rendering Telemedicine services to developing countries:

- Context specific advice must be given taking into consideration appropriate technology and resources;
- Ethical considerations such as the advice provided must be useful to the health care worker;
- The resources that are available to the treating health care worker must be taken into account;
- Trust issues where the advice is provided by an unknown second party and
- The issue of responsibility for capacity building of the developing world.

Sorenstom (2010) went further and provided some solutions to the challenges described above. These include that no single technology or person can be successful on its own, Telemedicine must rather be integrated into the approach of health care focusing on areas where it can alter health outcomes. Better commitment, collaboration and communication between professionals and the private-public partnerships must be established. Technology should be kept simple, relevant and local where possible. The technology and systems in place must be identified and used instead of providing a new solution which will create additional work for health care workers. A participatory approach must be used when installing the technology but monitoring

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and evaluation must be built into the system in order to measure the success of the system objectively. Loots (2010) concurred with the above and suggested 4 pillars that Telemedicine must adhere to. These pillars are building capacity and capability; creating new technical devices and decision support systems to generate information from the raw data; increasing technical knowledge and monitoring the impact of Telemedicine as an evaluation tool. The next section provides examples of Telemedicine projects in Africa.

3.3 TELEMEDICINE IN AFRICA

The WHO has recommended that Sub-Saharan countries make use of Telemedicine to address the inequities of the health care system. The advantages of Telemedicine according to the WHO is the improvement in accessibility, quality of health care, provision of services in rural areas as well as providing access to distance training for rural based health care workers (Kifle *et al*, 2008). The following section provides a variety of different Telemedicine projects that have been implemented in various African countries.

Satellife piloted a Telemedicine project in Ghana, Kenya and Uganda. The project made use of Personal Digital Assistants (PDAs) which were used by health care workers to carry out surveys. Medical reference material from textbooks was also made available on the PDAs in order to provide easy access to health care information (Chetty, 2005).

In Mozambique a teleradiology unit was established between Beira and Maputo hospitals. The system consisted of 2 Personal Computers equipped with radiological digitizers which allowed for the annotation of images, verbal descriptions of a patient's case and scanning of patient records. The system was found to provide access to specialist opinions while being cost effective (Chetty, 2005).

The RAFT 'Keneya Blown' project was initiated in 2001 in Mali by the University Medical School in Bamako and financed by the Geneva government and University Hospitals. The aims of the project was to support the primary education care through making continued medical education accessible to rural health care workers thereby retaining and recruiting to rural areas as well as building capacity for quality research in these areas. The creation of educational content, which

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is applicable to the realities of rural countries, was also an added advantage of the system. The collaboration between Mali and Switzerland made use of 4 dimensions:

- North-South tele-education where healthcare workers in Mali requested specific continued education topics to be developed and broadcast according to their needs. Scientific conferences were also web-cast with simultaneous translation into French.
- South-South tele-education where public health courses developed in Mali could be web-cast to regional hospitals in Mali and other parts of Western Africa.
- South-North tele-education where medical students training in Geneva could be educated by experts in Mali on tropical medicine.
- Tele-consultation between Geneva, Mali and other parts of Western Africa was used to enable remote examinations of patients or the review of radiographic images.

Some of the problems experienced during this project included infrastructure e.g. power supply instability, limitation of international bandwidth and the unreliable connectivity beyond the large cities. The educational content was found to be inadequate at times due to the differences in diagnostic and therapeutic resources and techniques between Switzerland and Mali (Bagayoko, Muller, Geissbuhler, 2007).

Currently there is a proposal for the development of an International Center of Excellence for eHealth in Africa (ICEEHA). This center will be based in Nigeria at the Graduate School of the Abia State University Teaching Hospital. The aim of the ICEEHA will be to provide educational opportunities for students of medicine from across Africa through a partnership with various educational and healthcare institutions e.g. University of Tampere in Finland, Information Technology Providers and NGOs. Through education ICEEHA hopes to enhance the socio-economic structure of Nigeria and the capabilities of the healthcare system. The benefits of the system include providing patients with second opinions for various infectious and chronic diseases and minimizing dependence on tertiary hospitals as well as limiting unnecessary travel to these facilities. Another added benefit of the training is that it reduces medical errors. This is important as it has been estimated that 2 million deaths occur annually in Africa because of medical errors. Community development is also an important feature of the system as it connects non-profit organisations (educational institutions and libraries) to the rural areas which in the future may attract domestic and international investors to the health care and educational sectors, through improving job opportunities. As participants can share the cost of an expensive

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digital satellite the use of broadband wireless Internet for the project will make the project feasible for these stakeholders (Oji, Utsumi and Uwaje, 2005). The next section focuses on Telemedicine projects in South Africa.

3.4 TELEMEDICINE IN SOUTH AFRICA

The Minister of Health, Dr. Motsoaledi, in his opening address at the MTN Foundation South African Telemedicine Conference in Cape Town stated that only 32 out of 86 Telemedicine sites are operational in South Africa. He remarked that even though the number of sites had increased from 28 in 1999 to 86 at present, the promise that the technology had provided as a communication and development tool for skills capacity building had not been realised. Even though South Africa is spending far more money than other developing countries with similar profiles, the output of these investments is much poorer when measured against these countries. The reasons for this poor performance are as follows (Motsoaledi, 2010):

- Lack of coordination and leadership;
- Insufficient budget and mismanagement of funds available;
- Weak IT infrastructure and connectivity;
- Lack of specific posts in the provincial structures and
- Lack of coordination and management between the various stakeholders.

The Department of Health is the founder of the Telemedicine Program at the South African Medical Research Council (MRC). In 1999 the Department of Health and the MRC identified the need for an entity to conduct research regarding Telemedicine including monitoring and evaluation (Motsoaledi, 2010).

The South African National Telemedicine Strategy aims to integrate the healthcare system by connecting and giving support to the remote and rural medical centers of South Africa and most importantly, strengthening the referral systems (Tshabalala-Msimang, 2007). The South African Government has also adopted Telemedicine as a formal method to achieve the Rural Health Strategy. This strategy aims to provide rural health services that are equal to urban health services in quality, accessibility, care and standard by 2009 (Rural Health Strategy, 2007). The aim of the Telemedicine projects in South Africa is to support the primary health care system in

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particular for women and children. Here the focus is to provide an early diagnosis and intervention enabling the health care worker to find diseases while they are still at a preventable or curable stage (Rural Health Strategy, 2006).

Telemedicine has also been linked to the Millennium Development Goals (MDG) as put forth by the WHO. The Telemedicine strategy has been updated to include and contribute directly to 3 of the outputs of the MDGs. These include increasing maternal health, decreasing child mortality below 5 years of age as well as combating HIV/AIDS and TB (Motsoaledi, 2010). South Africa's progress in achieving these goals has been dismal during the past 16 years according to a recent review. The life expectancy in South Africa has been reduced by almost 20 years since 1994 exacerbated by the rise in HIV-related mortality; the average life expectancy at birth is now 50 years for men and 54 years for women. There has been a reversal in the child mortality rate progress from 69 to 76 child mortalities per 1 000 live births and no improvement in the maternal mortality rate in the country. There is some progress being made towards the combat of HIV/AIDS, malaria and other diseases but not sufficient to reach the MDG by 2015 (Chopra, 2009).

There are however concerns that the Telemedicine strategy in South Africa is still not comprehensive enough and operates in a fragmented fashion. Some of the suggestions that have been forwarded to correct this situation include the following (Hanekom, 2010):

- The scope for different initiatives must be broadened and encouraged;
- A steering committee within the Department of Science and Technology must be set up to investigate how to provide the best return on investment once resources have been mobilised;
- How to move pilot projects into a national programme;
- ICT must not be seen as a means to an end, but must be used to provide value for money and
- All stakeholders must work collectively, not in a fragmented fashion.

The primary function of Telemedicine is to provide specialist consultation to rural communities as well as to provide learning opportunities to health care workers in these areas. Some of the services it encompasses include telepsychiatry, teleradiology, telepathology, teledermatology

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and teleophthalmology (Cellar *et al*, 2003). The initial project in 1998 was to implement Telemedicine in three phases over a period of five years. Since then serious concerns have been raised about various technical problems and project management, but the overall response from the health care workers has been positive (Strachan, 2001).

South Africa is seen as one of the world leaders in Telemedicine among developing countries according to the WHO. This is due to more sites being connected up and the wide range of medical procedures that can be provided making use of Telemedicine. South Africa started relatively late with its development and investment in Telemedicine, but this has created the opportunity to learn from the mistakes of other countries. The most important lesson being that for Telemedicine to be successful, it must be incorporated into the daily routine of the health system instead of being set aside as a special project (Strachan, 2001). At present the services offered by Telemedicine include radiology, opthamology, ultrasound and antenatal screenings. Other functions include conducting research, collecting statistical data and providing educational opportunities. Advantages reported include sharing skills between rural and urban centres thereby eliminating the problems of resource scarcity in rural areas, saving transport costs and that diagnosis and treatment can be given immediately by the specialist (Strachan, 2001).

The Department of Science and Technology (DST) has invested R15 million in various Telemedicine projects in recent years. This includes R7 million awarded to the KwaZulu-Natal Telemedicine Strategy Project, R2 million for Telemedicine as part of the South Africa-China bilateral agreement and R6 million awarded by the Innovation Fund to the MRC and Stellenbosch University to develop Telemedicine workstations. The third version of the workstations that were developed are currently commercially viable and MTN SA Foundation invested a further R4,8 million to roll out Telemedicine in public health care facilities. This clearly indicates that South Africa can develop and implement their own technology to empower people in the health and various other sectors (Hanekom, 2010).

One of the main problems experienced initially by the early Telemedicine projects was the unreliable telephone system in rural areas, but this is being addressed by making use of radio frequencies and satellite systems instead. The bandwidth needed to transmit a given amount of information within a fixed period of time is also of concern as far as size, cost and capability of the Telemedicine system is concerned. This is illustrated by sites experiencing serious technical problems 9 months into their operational stage (Strachan, 2001). The evaluation of

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Telemedicine is made difficult as the outcomes cannot be measured or quantified in monetary terms. The comparison most often used is between Telemedicine and the absence of the system which is also difficult as in many parts of the country the service provided was not available previously (Strachan, 2001).

In 2004 the Medical Research Council and Stellenbosch University collaborated to develop the Primary Health Care Telemedicine Workstation. The aim of this project was to produce a Workstation which would be affordable, able to withstand wear and tear, locally maintainable, be user friendly to operate and allow for automatic and/or remote configuration. The pilot site was the Grabouw Community Health Centre with the peripheral site at the Hottentots Holland and Tygerberg Hospitals. The turn around time for responses to referrals was found to be less than 48 hours (Fortuin and Molefi, 2005).

The HIV/AIDS pandemic has been singled out as an area where Telemedicine can make a definite contribution in South Africa. An international organisation, the Constellation for AIDS Competence, conducted a study in South Africa in 2006 and made the following recommendations for health management for people living with HIV/AIDS in the developing world. The recommendations concluded that by implementing a comprehensive Telemedicine system the following areas can be improved (Sorenson, 2010):

- Better access to drugs;
- Increase prevention of HIV/AIDS;
- Less exposure of health care workers;
- Improved follow-up of post-traumatic stress of the HIV-infection;
- Increase the knowledge of psycho-social behaviour towards health and
- Increase the knowledge of how Telemedicine is perceived and may be utilized in the cultural context of disadvantaged groups.

As a result of this study a project proposal called 'e-health Toolkit: Developing Sustainable Public Health Technology for HIV/AIDS Management' was developed for the management of HIV/AIDS in under-resourced settings. The pilot project was conducted at a selection of Anti-Retroviral Treatment sites in the Western Cape, South Africa (Sorenson, 2010).

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The South African version of *HealthNet* is called Interactive Learning, Communication and Management (ICAM) which provides the Department of Health with interactive video based classrooms for learning and teaching. It aims to encourage viewer participation and enhances comprehension and information retention making use of interactive two-way communication. It was launched by the Free State Department of Health and won the CPSI innovation award in 2003 (Tamasana and Mamogale, 2004).

Despite the backing of the National Department of Health and Medical Research Council to introduce Telemedicine to improve health care in rural areas, the uptake of Telemedicine has been limited at best. An example of a failed project is the National Telemedicine Lead Programme which was first introduced by the South African Medical Research Council. Provincial Departments of Health failed to incorporate it into their provincial health care strategies. Reasons cited in literature for this include technical and organizational challenges, failure to provide adequate and ongoing training, legal and ethical issues and user acceptance barriers. As a result, the National Department of Health's pilot projects have not expanded into a national programme as envisaged. The success of subsequent projects in KwaZulu-Natal and the Eastern Cape has led to a resurgence of interest in telemedicine, with projects running or planned in KwaZulu-Natal, the Eastern Cape, Limpopo, Mpumalanga and the Western Cape (Jack and Mars, 2008).

Research conducted to evaluate the efficiency and effectiveness of Telemedicine in South Africa has largely been done by international development organizations such as the IDRC, World Bank, telecommunications operators and non-government organizations (NGOs). In contrast, very little research has been undertaken by computer scientists from South Africa (Chetty, 2005).

Other South African initiatives include the Short Message Service (SMS) being used to alert Tuberculosis (TB) patients to comply with their medication schedules. The Compliance Service Company works in conjunction with the city of Cape Town and sends out the SMSs to remind patients to take their medication in order to prevent defaulting. This is important as it prevents defaulting and the subsequent increased resistance to TB drugs which leads to Multi Resistant Drug TB (Chetty, 2005).

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The Tygerberg Children's Hospital in Cape Town started an initiative to provide specialist support to outlying district hospitals. It makes use of the provincial Intranet which connects all the provincial hospitals via e-mail. Doctors in outlying hospitals can e-mail x-rays and special tests to Tygerberg hospital where one person will scan all the incoming queries and direct them to the relevant specialists within the hospital. The diagnosis and proposed treatment is then sent from the specialist to the original referral hospital (Chetty, 2005).

The Redcross Memorial Children's Hospital has recently upgraded to digital theatres that can be used for training via distances. The advantages of making use of the digital equipment includes decreased patient time in surgery and hospital as it is a less invasive surgery, less post operative pain as well as increased output for the surgeons. When the technology is used for training purposes it provides the surgeons with instant access to information, improved documentation, reduces mistakes, increases the visual interactive teaching experience and can be used for team building as all the participants in theatre can see what is happening (Numanoglu, 2010).

Interactive Learning, Communication and Management (ICAM) were initiated by the Free State Department of Health. The system makes use of technology based on one-touch solutions which provide the department with 40 interactive video-based classrooms for learning and teaching. ICAM makes use of two-way communication to improve interactive viewer participation which has been shown to improve comprehension and information retention making learning more effective. The presenter can track participation and activities (yes/no, true/false, multiple choice questions) undertaken during teaching allowing for monitoring and interaction with students. The system can compile composite results of responses to questions in real time which can then be displayed to everyone attending the training. Some of the topics presented making use of ICAM includes Primary Health Care, Advanced Midwifery and Continuous Professional Development activities. Future programs that will be run through ICAM include Financial and Health Programs, Waste Management, HIV/AIDS, TB and Communicable Diseases and Integrated Management of Childhood Illnesses. Benefits that have been recorded making use of this system include reduced cost as travelling and accommodation for

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students are eliminated as well as an increase in productivity as students are better prepared and miss less work due to study commitments (Sorenson, 2010).

Tele-audiology services are very necessary in South Africa as only 20% of the patients who apply to receive a hearing aid are successful. In addition 64% of HIV/AIDS patients will have some kind of hearing problem due to drug prescriptions. The benefit of Tele-audiology is that it automates the service which means less skilled workers can be used to administer the test saving professional human resource time. It also decreases the testing time because simple tests can be automatically interpreted via a computer programme making the waiting time and cost for hearing aids considerably less. Studies have shown that there is no significant difference between a face to face as opposed to a remote consultation. The services being offered at Witkoppen Provincial Clinic now offer virtual prescriptions, fitting of hearing aids via Tele-audiology, virtual training on how to use and look after the hearing aid as well as virtual follow-up visits (Koekemoer, 2010).

Recently the South African Government provided Telemedicine services to Southern Africa with partnerships founded with Namibia and the Democratic Republic of the Congo. Namibia will establish a Cardiology Unit at Windhoek Hospital making use of the medical staff at the University of Cape Town for expert assistance. The Democratic Republic of the Congo has started with a scoping and environmental scanning initiative as to how Telemedicine can be used successfully, but this project is still in the initiation phase (Motsoaledi, 2010).

A private initiative currently underway is the 'Hello Dr' web service which will be launched in conjunction with the ER Group. Initial tests conducted in private health care have shown that this service has the potential to decrease visits to the Primary Health Care clinic by up to 30%. It is thought that this percentage will be much higher once the service is launched in the public sector. The aim of this Telemedicine service is to provide consulting and e-prescribing services; appropriate clinical responses to medical emergencies; expert medical support for first line services and appropriate health information via behavioural modification messages (Holt, 2010).

Training has also been commenced with the University of Stellenbosch in conjunction with the MRC providing a short course in Telemedicine called the "Introduction to Telemedicine". The

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MTN SA Foundation has provided 18 bursaries to employees of the provincial Departments of Health in order to attend this course with the first graduates expected in September 2010 (Hanekom, 2010). Linghamp (2010) argues that tertiary institutions will have to include Telemedicine in their curriculum as the applications will continue to grow in the future. There will have to be institutional 'buy in' for this to happen and a monitoring tool will have to be designed to monitor the effectiveness of Telemedicine in general. The next section focuses on the Telemedicine strategy and pilot projects in the Eastern Cape.

3.5 TELEMEDICINE IN THE EASTERN CAPE

The Eastern Cape Telemedicine is part of the National Health Information System of South Africa Committee (NHIS/SA). At the provincial level the project is coordinated by the National Health Information System (NHIS). The strategy for the development of the South African Telemedicine System is to implement the system in three phases. The first phase started in 1999 and involved setting up Telemedicine sites in six provinces with thirty functional sites. At the end of phase three the project will be ready to move out of the pilot stage into the clinical application stage (Telemedicine Operational Plan E-health, 2009). The second phase is due to start in 2002 and the Telehealth Distance Education project will form part of this phase. This will involve establishing a network of all the eight medical schools to support the existing sites and a further seventy-three Telemedicine sites planned for phase three. The aim is to provide continued medical education and support for health care workers in rural communities and provide access to specialist care to rural communities without travelling long distances. This will bring the expertise of the health care specialists, at present mostly concentrated in the urban centres closer to the rural areas, the advantage being a reduction in cost especially travelling costs, improved clinical care delivery and supportive primary health care services (Telemedicine Operational Plan E-health, 2009).

Specialised care in the Eastern Cape is very scarce. There are only 2 dermatologists, 2 radiologists, 2 oncologists and no oral health specialists in the public service. Further problems experienced include poor infrastructure, lack of transport and isolation of the rural clinics as well as the increasing workload due to HIV/AIDS. Literature provides suggestions on why it is difficult to attract and retain staff in rural areas. Professional isolation from their peers and the

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lack of access to training opportunities contributes to keeping health care workers away from the rural areas (Telemedicine Operational Plan E-health, 2009).

The following table explores the health care worker ratio to population per province in the country. In many of the categories the Eastern Cape has the highest health care worker per population ratio in the country reflecting that the province is severely understaffed (Telemedicine Operational Plan E-health, 2009).

Table 4: Health care worker to population ratio in the Eastern Cape (Telemedicine Operational Plan E-health, 2009).

Health professionals	Eastern Cape ratio (1 to)	Other provinces ratio (1 to)	Comment
General practitioner	8 825	273 (Gauteng)	Highest ratio in country
Medical specialist	47 529		Third highest ratio in country
Professional nurse	1 278		Highest ratio in country
Dentist	190 117	25 458 (Gauteng)	Highest ratio in country
Physiotherapist	237 646		Highest ratio in country
Pharmacist	53 662		Highest ratio in country
Occupational Therapist	554 507	3 932 (Free State)	Highest ratio in country

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Speech therapist	950 583	79 714 (Gauteng)	Highest ratio in country
Dietician	475 292	54 635 (Gauteng)	Highest ratio in country

The above statistics are supported by the Health System Trust which reported in 2005 that almost a third of public health care worker posts were vacant in the Eastern Cape. This situation is not improving as Cullinan and Thom (2005) found in their report; the province was finding it difficult to attract health care workers to the rural areas due to unattractive working conditions.

Since 2001 the Eastern Cape has become known as the Telemedicine leader in South Africa since the province was one of the first to pilot Telehealth (Khumalo, 2004). Extensive research was done both nationally and internationally regarding the design of other Telemedicine projects before the Eastern Cape strategy was developed. The strategy was designed in line with the Department of Health's strategic goals based on traditional and technology based service delivery. This was due to the changing expectations of rehabilitation, education, training, organizational and leadership in the province. The strategic plan for Telehealth includes the following 3 main objectives: Management and administration, Education and training and Academic and clinical support. The strategy to achieve these 3 objectives includes the following (Telemedicine Operational Plan E-health, 2009):

- Telemedicine must become part of the managerial structure of the provincial Department of Health;
- The establishment of centres of E-health education;
- To coordinate research and
- To develop specialised consultation sites and to implement fully functional E-health packages in every district hospital and clinic.

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The South African Position Paper at the Information Society and Developed Conference (ISAD) was used to provide a framework for the implementation of Telemedicine in South Africa in general and the Eastern Cape in particular. One of the important issues it addresses is the development of local expertise and sufficient skills transfer to the Health District Level. This is to ensure the sustainability of the initiative. Another priority of the Paper is the amalgamation of South African medical schools for cost-effective medical education and to facilitate recruitment and retention of health care providers in rural communities. Other deliverables include (Telemedicine Operational Plan E-health, 2009):

- Functional clinical services to remote rural communities of South Africa;
- Education and training of South African rural healthcare providers;
- Technical task teams for developing: Tele Education, Clinical Protocols, Legal Licensure Ethics and Infrastructure systems and guidelines;
- Ensuring that an affordable, clinically acceptable Primary Care Telemedicine Workstation suitable for the region is researched;
- Efficient management of clinical cases and
- Using appropriate Telecommunication Infrastructure.

Telemedicine is envisaged to assist the province in achieving its objectives in terms of child health, maternal health, TB and other chronic diseases, HIV/AIDS and Oncology (Telemedicine Operational Plan E-health, 2009).

The above points will be realised through ICT bridging the gap between the rural areas and urban areas where services are available, attracting and retaining health care workers to rural areas, capacity building, training, education and Continued Professional Development (CPD) points delivery, providing specialist care without moving patients and providing a proper referral management system (Telemedicine Operational Plan E-health, 2009).

Telemedicine in the Eastern Cape was first introduced at Walter Sisulu University (UNITRA) in 1995. The Eastern Cape Department of Health initiated a telepathology link between Walter Sisulu University and sites in the United States of America, Germany and Croatia. After this the

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telecytology project linking St Elizabeth Hospital in Lusikisiki and Mthatha General Hospital was established (WSU Telemedicine, 2008).

The Eastern Cape Telemedicine Unit was formally established in 1999 to co-ordinate research and the implementation of Telemedicine projects around the former Transkei. Some of the services provided included online training for Emergency Medicine students around the province as well as teleradiology, telepathology and teledermatology (WSU Telmedicine, 2008).

By 2005 the Eastern Cape Department of Health had established 12 Telemedicine sites around the province including four teleRadiology sites at St Barnabas, SS Gida, Humansdorp and Knessie Knight Hospitals (Khumalo, 2004). The Eastern Cape Department of Health had by 2008 extended Telemedicine to include 27 clinics of excellence where teleConsultation was available and had rolled out E-health District Packages which included teleDermatology, teleECG, teleSpirometry, teleRadiology and teleTrauma to 5 district and 1 regional hospital. The provincial E-health education centre provides assistance to health care workers to further their education in 3 academic programmes: Dental assistant course via the University of Cape Town, Masters Program in Telemedicine via the University of Kwazulu Natal and a Pharm D Program via Rhodes University (Telemedicine Operational Plan E-health, 2009).

The very first pilot Telemedicine site in the Eastern Cape was the Tsilitwa village project. Some of the problems experienced at this pilot site included frequent power failures during which Telemedicine could not be used for extended periods of time. Staff shortages also meant that Telemedicine became an additional duty for the only doctor employed at the hospital making scheduled times for consultations extremely difficult. The problem was alleviated when a 'store and forward' approach was introduced which resulted in an increase in the amount of patients being processed at the hospital. It was also found that voice calls were of better quality than the VoIP phones previously used (Chetty, 2005). Currently this project is not functional (Loots, 2010).

A Teledermatology service was established in 2005 between Uitenhage Hospital and Cecilia Makiwane Hospital in East London where the only dermatologist in the Eastern Cape Province is currently practising. It was found that 75% of unnecessary referrals to the dermatologist were saved while 80% of the pictures taken for Telemedicine referrals were of a quality good enough for diagnostic purposes. The turn around time for referrals is 24-72 hours making use of a store

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and forward approach. Currently this project is being expanded to other hospitals in the area. Advantages reported from this study include increased skill capacity and confidence of health care workers as well as an increase in the quality of the services provided. For patients there was a cost saving and reduced waiting time reported. Some of the problems experienced with this project included initial resistance from the staff to make use of the technology; this was overcome by making use of a champion who drove the service. Ethical considerations such as confidentiality were addressed by not sending any identifiable information to the specialist (no identifiable face images or names), access to the equipment was initially restricted by security measures and the size of the electronic data was found to be too large to send via e-mail. This problem was overcome by compressing the files before they were e-mailed to the dermatologist. (Kapp, 2010).

3.6 CONCLUSION

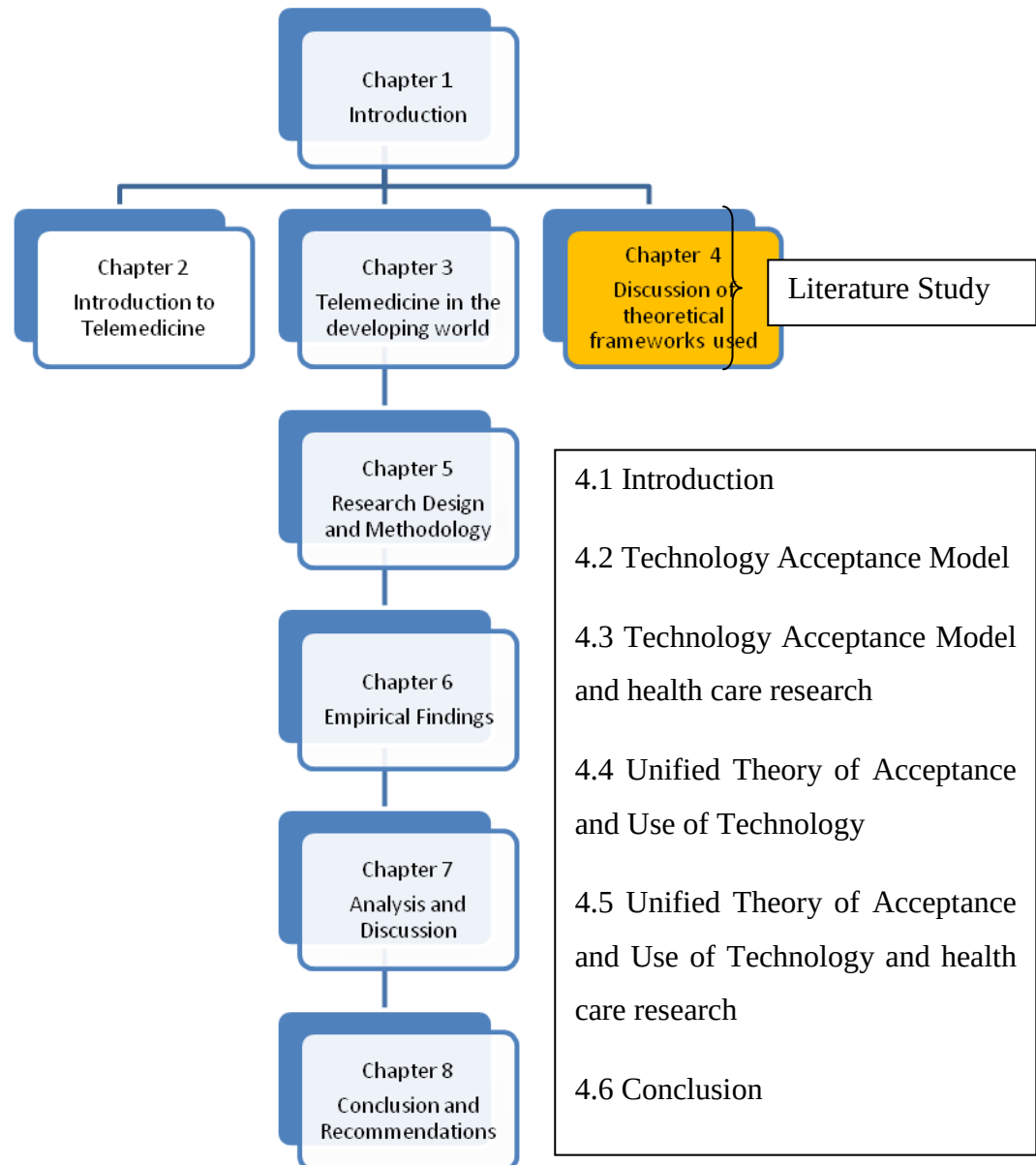
This chapter explained the uses of Telemedicine in the developing world through various projects described in literature. These projects were taken from various developing countries both in and around Africa and were diverse in the application of the technology (education, consultation and rehabilitation).

Telemedicine in South Africa was discussed making use of policy documentation as well as pilot projects that have been set up by both NGOs and the Department of Health. Again the application of these pilot projects was diverse in nature ranging from education to medical consultations and even SMS notification systems.

The Eastern Cape was highlighted as a leader in Telemedicine and the policy of the province regarding the technology was provided. Some of the projects initiated in the province were discussed investigating the problems experienced. The next chapter will discuss the theoretical framework used in the research study.

Chapter 4

Telemedicine and Theoretical Models



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4.1 INTRODUCTION

Different models have been used in literature to measure and explain user acceptance issues concerning Telemedicine. Two of these models and their respective effectiveness are discussed in this chapter.

The potential benefits of Telemedicine in health care have been well documented in past literature, but the value of the technology is largely dependent on it being accepted and implemented successfully by the technology users (Kifle *et al*, 2008). This is supported by Lemma (2004) who reports that despite the proven advantages of ICT in health care, it cannot be translated until health care workers realise the benefit of the technology.

User acceptance reflects whether a system fits the characteristics of the users and the task which must be performed. This means that user acceptance can be used as an indicator to measure whether an information system really supports health care workers in their clinical working processes and ultimately as an indicator for the overall system success (Friedland, 2001; Dhillon and Forducey, 2006).

Developing countries usually implement Telemedicine from a foreign entity which means that the technology itself is inserted into the local context. This would suggest that culture and the efficacy of the technology transfer are important for user acceptance of the technology (Kifle *et al*, 2008).

The next section discusses in detail two models that have been used extensively in Information System literature to evaluate and explain user acceptance of new technology. The Technology Acceptance Model and Unified Theory of Acceptance and Use of Technology are explained making use of relevant theoretical frameworks after which the conclusions in the studies found making use of these two models are highlighted.

4.2 TECHNOLOGY ACCEPTANCE MODEL (TAM)

There are many studies that have recorded the unintended consequences of IT in health care. The majority of these studies have found that the fit between the technology and the clinical work system leads to the end users either incorporating the technology into their daily routine or working around it. Studies have also documented that the under use or resistance toward technology, workarounds and overrides, sabotage and abandonment are activities frequently

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found when new technology is implemented into health care. For management this means that the success of these IT systems will be determined on the ground level and not by the decision makers (Holden and Karsh, 2009).

One of the models used extensively in the past to explain and predict end user reactions to IT in health care is the Technology Acceptance Model (TAM). This model is the golden standard in Information System literature claiming as much as 10% of all Information System publications. The aim of the model is to increase the use of technology through increasing acceptance of IT. The means through which this is frequently assessed is by asking an individual about their future intentions to use the specific technology and by making use of this knowledge, manipulate the relevant identified factors in order to promote acceptance and subsequently increase the IT use. Early TAM research found that only 3 factors (*Perceived usefulness*, *Perceived Ease of Use* and *Behavioral Intention to Use*) were necessary to explain, predict and ultimately control technology acceptance (Holden and Karsh, 2009).

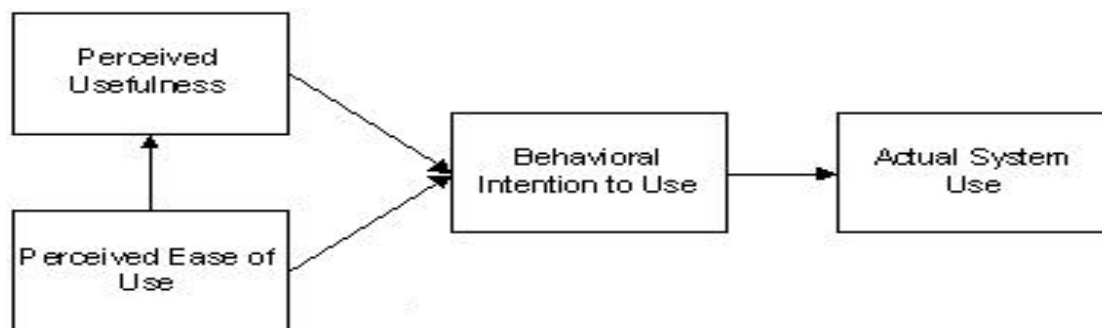


Figure 4: TAM (Davis, 1989)

The TAM is tailored to the Information System context. The model is based on the Theory of Reasoned Action and was proposed by Davis in 1989. The Theory of Reasoned Action (TRA) was first introduced by Fishbein and Ajzen (1975) and is a well-researched intention model that can be used in a wide variety of domains to predict and explain behaviour including technology acceptance. The TRA framework is based on the distinction between beliefs, attitudes, intentions and behaviours. Making use of the TRA, an individual's performance can be determined by specified behaviour influenced by his or her behavioural intention to perform the

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behaviour. This behaviour is jointly determined by the person's attitude and subjective norms concerning the behaviour in question (Al-Gahtani and King, 1999).

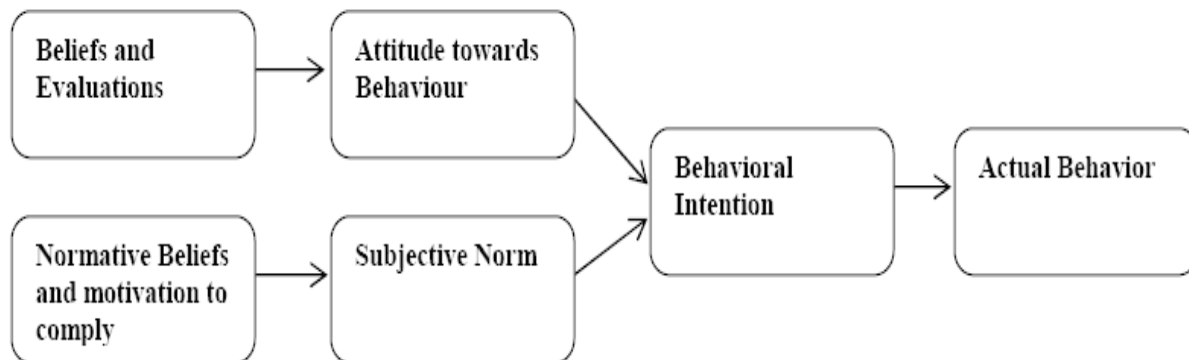


Figure 5: The Theory of Reasoned Action (Fishbein, and Ajzen, 1975)

The TAM uses the TRA as a theoretical basis in order to specify the causal relationship between the two key constructs – *perceived usefulness* and *perceived ease of use*. These two constructs can be used to predict the ultimate intention of an individual to use an information system. The actual usage of an Information System can be measured making use of the original intent the user exhibited (Davis, 1989).

The definition of *perceived usefulness* is the degree to which a person believes that a particular information technology will enhance their job performance while *perceived ease of use* is defined as the degree to which a person believes that using the technology will be free of effort (Davis, 1989).

TAM has been validated and applied to a diverse set of technologies and users in both a voluntarily and mandatory setting (Venkatesh, 2000). It is considered a very reliable and robust model as it has been proven to be applicable to individuals of all levels of IT competency, gender and ages (Yarbrough and Smith, 2007). McCoy, Everard and Jones (2005) also showed it can be used in most cultures.

One of the disadvantages of TAM is that it assumes that the individual will be free to act without any limitations. In practice however there are several barriers that can limit the ability of an individual to use technology. These include ability, time, environmental and organisational limits, resource scarcity and unconscious habits (Davis, 1989; Yarbrough and Smith, 2007).

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Venkatesh (2000) pointed out that some of these concepts e.g. experience, gender and voluntariness, were not included in the original TAM. Literature has indicated that for the TAM to accurately predict technology acceptance, context-specific variables must be added in order to increase the explanatory power of the model (Yarbrough and Smith, 2007). These context-specific variables include a variable meant to capture the social influence that compels end users to make use of IT, called subjective norm (Holden and Karsh, 2009). This is supported by Straub (2009) who commented that one of the main criticisms of the TAM is the lack of acknowledgement of individual differences. The original TAM does not include prior experience, age, gender and many other characteristics that may influence attitudes about and acceptance of technology.

The following figure provides a graphical representation of the original TAM model and the improvements made in the subsequent TAM2 model.

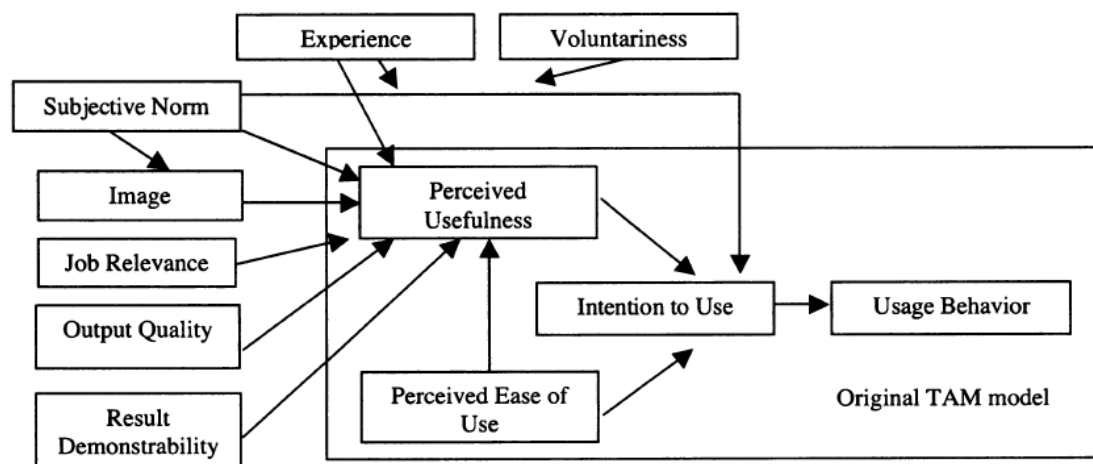


Figure 6: Extended TAM model (Venkatesh and Davis, 2000; Lee, Kozar and Larsen, 2003).

Venkatesh (2000) extended the original TAM to address these limitations. Two additional factors were included in TAM2 which directly influenced *perceived usefulness*:

- cognitive instrumental processes (job relevance, image, output quality, result demonstrability) and

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- social influence/subjective norms processes (experience and voluntariness).

The definition of the additional factors can be found in the following table.

Table 5: Definitions of TAM2 variables (Venkatesh and Davis, 2000)

JOB RELEVANCE	Individual's perception of the degree to which the technology is applicable to their job
OUTPUT QUALITY	Individual's perception of how well a system performs a task necessary to his or her job
RESULT DEMONSTRABILITY	Tangibility of results from using the technology
PERCEIVED EASE OF USE	Impacts on <i>perceived usefulness</i>
SUBJECTIVE NORM	Person's perception that people who are important to them think they should or should not use the technology
IMAGE	Degree to which one perceives the use of the technology as a means of enhancing one's status within a social group
VOLUNTARINESS	Extent to which one perceives the adoption decision as non-mandatory

Further additions to TAM2 include the use of 'anchors' and adjustments' which directly influence *perceived ease of use*. 'Anchors' adds concepts such as computer self-efficacy, perceptions of external control, computer anxiety, and computer playfulness to the model while 'adjustments' provide for concepts such as perceived enjoyment and objective usability (Venkatesh and Davis, 2000; Lee, Kozar and Larsen, 2003). There are 3 ways through which social influence will affect individuals. These are compliance, internalization and identification. Compliance means that an individual will change their intention in response to social influence. Both

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internalization and identification mechanisms will alter the individual's belief structure and thereby enhance the motivation of the individual to accept the technology (Venkatesh, Morris, Davis and Davis, 2003).

The ability to predict explained variance increased from 25% making use of the original model (TAM) to 40% after the extensions were made to TAM2 (Venkatesh and Davis, 2000; Lee, Kozar and Larsen, 2003). The next section provides an overview of the TAM and health care research that has been conducted making use of this model.

4.3 TECHNOLOGY ACCEPTANCE MODEL AND HEALTH CARE RESEARCH

The health care industry has not embraced IT as other industries have done (Menon, Lee and Eldenburg, 2000). The TAM has been used to explain the acceptance of technology in many different settings and with a variety of users. It is one of the most used theories in Information Systems and has been validated in literature as both reliable and robust (Venkatesh, 2000).

Chau and Hu (2002) found that health care workers have fundamental differences from other types of users when making decisions about technology. This is supported by Tule, Horan and Burkhard (2005) who found in their study that health care workers have distinct characteristics which differentiate them from other user groups and make them a challenging group to accept new technology. These characteristics include being highly time-constrained, dealing with confidential information and an increased intellectual and cognitive capacity which enables them to adapt to and comprehend new technologies quicker (Hu, Sheng, Chau and Tam, 1999). Dixon and Stewart (2000) as well as Chismar and Wiley-Patton (2003) reported similar results. It was found that while health care workers are expected to work autonomously, management of hospitals cannot force them to adopt specific Information Systems (Chau and Hu, 2002). Bhattacharjee (2001) also argued that in addition to usage behaviour the professional's satisfaction with the system will also contribute positively to the continued usage of the technology. The satisfaction of the individual will be determined by their personal experience of the system as well as the team environment in which they receive the emotional and objective consequences of using the system. Further differences of health care workers include their professional autonomy and authority while performing their professional tasks (Wallace, 1995).

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This means that it is difficult to influence or control professionals by explicit rules of bureaucracy, management authority or price mechanisms (Ouchi, 1979).

Several studies found that TAM had some limitations when predicting whether health care workers would use Telemedicine or not and that additional factors should be incorporated to improve the success rate (Hu *et al*, 1999; Hu, Chau and Tam, 1999). Chau and Hu (2000) however reported that TAM still remains a more appropriate theory to use than the Theory of Planned Behaviour or other integrated models.

Health care workers are also reported to be more pragmatic than other user groups when accepting new technology. Chau and Hu (2002) and Chismar and Wiley-Patton (2003) found that health care workers will adopt ICT if it is beneficial to the patient even though it might not be user friendly. This would explain why literature reports *perceived usefulness* and not *perceived ease of use* to be critical within this user group. Other considerations include technology relevance to patient care as well as the quality and output of the system. Furthermore health care workers find a technology useful if it increases their productivity, quality of care, effectiveness and overall service (Tule *et al*, 2005).

Social influence such as peer pressure was not found to influence health care workers when making decisions to adopt new technology (Chismar and Wiley-Patton, 2003; Chau and Hu, 2002). Further suggestions were made by Yarbrough and Smith (2007) to include external factors such as time, organisational issues, system-specific issues and personal factors in the TAM. They argued that these factors are unique to the health care setting and must be included in order to improve the accuracy of the prediction.

Holden and Karsh (2009) found in an analysis of 20 studies making use of TAM to predict health care workers acceptance of new technology that *perceived ease of use* and acceptance of technology was significant in all of the studies. The same was reported for *perceived usefulness* and the intention to use new technology, although *perceived ease of use* and intention to use was only significant in 53% of the studies. Subjective norm on intention was only significant in 50% of the studies while facilitating conditions was significant in all of the studies. The reasons why *perceived ease of use* and social norms were not able to predict intention to use new technology was explained in these studies as the increased computer literacy of health care workers in comparison with the general population, that with time and

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practice the *perceived ease of use* construct of the system became no longer important to acceptance and use of technology. Other explanations included the disinterest of health care workers in the usability of the system as long as the system was useful to the patients and the availability of support staff for the health care worker to deal with the system. The researcher then concluded for technology to be accepted in health care it must be perceived as useful to the health care worker. *Perceived ease of use* is not likely to affect acceptance, but it does appear to correlate with usefulness. The reason for this may perhaps be that IT that is difficult to use cannot possibly be perceived as useful. The implication for the acceptance of new technology in health care then follows that design, training, and informational sessions must prioritise health IT as capable of improving health care outcomes and not be difficult to use. Further consideration must be given to facilitating conditions such as ensuring that the end user feels confident in their ability to use and control the technology that any barriers are removed and sufficient support provided when necessary. Holden and Karsh (2009) concluded that although TAM is able to predict fairly accurately if a new technology will be accepted, there is much room for improvement. Some of the issues mentioned include the need for standardization of terminology, more tests be done of certain relationships, better reporting of data in studies and continuous exploring of new theoretically motivated variables and relationships that can be added to TAM.

Siracuse and Sowell (2008) studied American pharmacists who made use of Personal Digital Assistants (PDAs) for professional use. Technology acceptance of the technology was investigated. The researcher found that *perceived usefulness* and attitude towards the system had the most significant influence on intention to use an actual PDA. No significant relationship was found between *ease of use* and intention to use on the actual PDAs.

Holden and Karsh (2009) found in their study of primary care physicians' and nurses' perceptions of using error reporting systems that perceptions of *usefulness*, *ease of use* as well as subjective norms were important when health care workers decided to accept or reject new technology. The next section discusses the theory of the Unified Theory of Acceptance and Use of Technology.

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4.4 UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)

The UTAUT was proposed by Venkatesh *et al* in 2003 as an extension of the TAM. It included several new constructs in order to improve the predicted value of usage of technologies. The model itself was formulated based on conceptual and empirical similarities across eight prominent competing technology acceptance models:

- TAM (Davis, 1989);
- Roger's Innovation Diffusion Theory (Rogers 1995);
- TRA (Fishbein and Ajzen, 1975);
- The Motivation Model (Davis, Bagozzi and Warshaw, 1992);
- The Theory of Planned Behaviour (Ajzen, 1991);
- The combined TAM and Theory of Planned Behaviour (Taylor and Todd, 1995);
- The Model of PC Utilization (Thompson, Higgins and Howell, 1991) and
- Social Cognitive Theory (Compeau, Higgins and Huff, 1999).

The UTAUT was validated in a longitudinal study which found it to be able to explain 70% of technology acceptance behaviour in health care workers, a considerable improvement on previous models which routinely explain only 40% of acceptance (Venkatesh *et al*, 2003).

The UTAUT is used to explain user intent to use Information Systems and the subsequent usage behaviour. The four key constructs that directly influence usage intention and behaviour are *performance expectancy*, *effort expectancy*, *social influence* and *facilitating conditions*. Aspects such as gender, age, experience and voluntariness directly impact on these key constructs (Venkatesh *et al*, 2003). This means that UTAUT has incorporated *perceived usefulness* into the *performance expectancy* construct, *perceived ease of use* into the *effort expectancy* and *social norms* into the *social influence* construct. It also provides an added construct called *facilitating conditions* which although not new to IT acceptance research, was not included in the TAM (Holden and Karsh, 2009).

Performance expectancy represents the degree to which an individual believes that using the system will help them to attain their goals in job performance. *Effort expectancy* is defined as the degree of ease associated with the use of the system. The extent to which an individual allows the opinions of others to influence their decision to use the system is called *Social*

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influence and *Facilitation Conditions*, the objective environmental factors that observers agree make the act easy to accomplish (Venkatesh *et al*, 2003).

In addition the UTAUT includes two theoretical mechanisms through which the *subjective norm* can influence intention indirectly through *perceived usefulness*. These two mechanisms are internalization and identification. UTAUT postulate that the *subjective norm* will positively influence image as peer pressure or acceptance will cause an individual to accept new technology in a social context (Venkatesh and Davis, 2000). The diagram below is a diagrammatic representation of the UTAUT model.

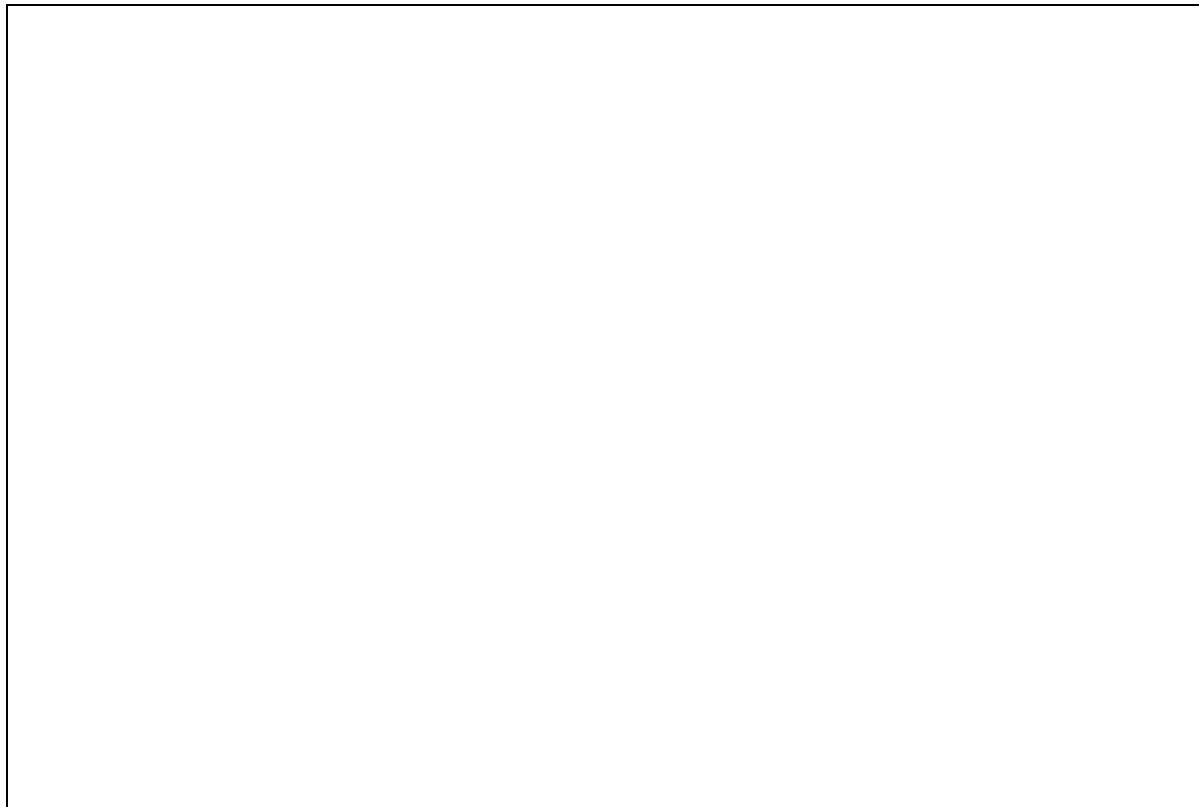


Figure 7: UTAUT model (Venkatesh and Davis, 2000)

The TAM is the most cited theoretical framework in Information System literature involving user acceptance of technology. Benbasat and Barki (2007) critically discussed the use of the TAM in Information Systems and suggested that the over-utilisation and emphasis of this model has diverted research efforts away from important research topics related to Information Systems

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adoption. The argument was made that this over-emphasis on the TAM has limited the progress of knowledge in the area of adoption and acceptance of Information Systems and suggestions were made to widen the theoretical framework for research conducted in this field. The UTAUT has been suggested as an alternative to the TAM and has grown in popularity since its inception with over 600 studies citing the source article as per the ISI Web of Science citation (Dwivedi, Mustafee, Lemuria and Williams, 2010).

Dwivedi *et al* (2010) produced a bibliometric comparison of the usage of the TAM and UTAUT models in Information System literature. They found that more than 70% of the highest occurring keywords in both models are repeated meaning that the models are being applied in similar contexts. The 14 highest cited papers in UTAUT also appear in the top 33 list of the TAM which means that these papers are relevant to both models. There are only two papers that appear as turning point papers in both TAM and UTAUT datasets, namely by Davis *et al* (1992) and Venkatesh *et al* (2003) making these studies of high importance to both models. The paper by Venkatesh *et al* (2003) is identified as both highly cited and a turning point paper for both models and is considered an essential starting point for authors who wish to pursue the research making use of the TAM or UTAUT models. The conclusion of the authors was that there are a number of similarities between TAM and UTAUT and that the authors who were using TAM earlier had shifted their focus to UTAUT in order to avoid the current criticism on the use of TAM.

Table 6: Summary of findings for the UTAUT model (Venkatesh *et al*, 2003)

Dependent Variables	Independent Variables	Moderators	Explanation
Behavioural intention	<i>Performance expectancy</i>	Gender Age	Effect stronger for men and younger workers
Behavioural intention	<i>Effort expectancy</i>	Gender Age Experience	Effect stronger for women, older workers and those with limited experience

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Behavioural intention	<i>Social influence</i>	Gender Age Experience Voluntariness	Effect stronger for women, older workers, under conditions of mandatory use and limited experience
Usage	<i>Facilitating conditions</i>	Age Experience	Effect stronger for older workers with increasing experience
Usage	<i>Behavioural intention</i>	None	Direct effect

Behavioural intent is influenced by *performance expectancy*, *effort expectancy* and *social influence*. *Performance expectancy* is influenced by both gender and age. Men will make use of the *performance expectancy* of the technology in order to predict if they intend to use the technology while the same holds true for younger workers. *Effort expectancy* is influenced by gender, age and experience. The *perceived effort* expenditure of learning to use a new technology will influence women, older workers and those with limited IT exposure to accept the technology or not. *Social influence* is influenced by gender, age, experience and the voluntariness of using the technology. Women, older workers and those with limited IT exposure will be more easily influenced by peers or management to accept the technology while workers that have to make use of the technology, are mandated by management to do so. Older workers with more exposure to IT are more susceptible to *facilitating conditions* in order to make use of technology while the general behavioural intent to make use of technology will directly impact on the actual usage of the individual (Venkatesh *et al*, 2003).

One of the key findings of the theory is the marked difference between the motivators for the adoption of technology for men and women. Men will make use of new technology based on their *perception of usefulness* while women will be influenced by their perception of the technology's *ease of use* (Venkatesh and Davis, 2000). Straub (2009) reported that the UTAUT will provide gender and age interactions with social pressure; women and less computer literate individuals were found to have higher effort expectancies. Age has also been shown as a contributor to the adoption of technology with older people tending to adopt new technologies

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much more slowly than younger users (Venkatesh and Davis, 2000). The next section explores the health care research that has been done previously making use of the UTAUT model.

4.5 UTAUT AND HEALTH CARE RESEARCH

Schaper and Pervan (2004) found that health care workers such as occupational therapists, nurses and doctors as a group exhibit different characteristics from other end users. This is similar to results found for the TAM when investigating user acceptance of technology for health care workers (Hu *et al*, 1999). Nuawabeza *et al* (2009) and Chismar & Wiley-Patton (2003) found that *social influence* while important for the prospective user of the technology, will diminish once the technology is in use. Managers must therefore minimize the negative aspects of social expectations and rather focus on the positive aspect. They also found that technology transference for continued use in medically underserved communities will be greatly influenced by *facilitating conditions*. The health care workers may not express this concern before they start using the technology, but this factor will increase as they become more familiar with the technology.

Effort expectancy was found to be associated positively with prospective users' behavioural intention, while the opposite was found for actual users of the technology. The researcher's conclusion was that those who were willing to commit the appropriate amount of effort were in fact the users that intended to continue using Telemedicine (Nuawabeza *et al*, 2009). This is in contrast to Chau and Hu (2002) and Chismar and Wiley-Patton (2003) who reported that *effort expectancy* was not applicable to health care workers when accepting new technology. Schaper and Pervan (2004) argued that due to the time demands placed on health care workers, technology that is perceived as easy to use will be accepted more easily. This is because the health care worker will not need to invest a large amount of time in learning how to use the technology.

Health care workers' attitudes towards computers and *performance expectancy* of the technology were found to be a very important determinant for acceptance of Telemedicine (Chau and Hu, 2002). *Performance expectancy* has been shown to be a consistent predictor of the health care workers' intent to use Telemedicine and is directly and indirectly influenced by the attitude of the user (Chau and Hu, 2002; Chismar and Wiley-Patton 2003). If the health care worker perceives the technology as being useful to their work practices, compatibility will directly

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affect both *performance expectancy* and *effort expectancy*. The technology is also more likely to be perceived as being useful if it is easy to use (Schaper and Pervan, 2004). This result highlights the need to address the users' concerns regarding the performance of new technology and how it will impact on the overall performance of the individual who is expected to use the technology. If this is not addressed it will lead to a slower or even failed technology transfer or pace of diffusion of the technology. These results indicate the importance of developing technology for health care workers that will support their *performance expectancy* and *social influence* while still ensuring ease of use (Wills, El-Gayer and Bennett, 2008).

Compatibility of Telemedicine with work practices, values and experiences of the health care worker has been shown to be one of the most important determinants in technology acceptance (Schaper and Pervan, 2004). The value placed on the patient doctor relationship cannot be underestimated and any technology which is perceived to be incompatible with this process will be rejected by health care workers. Lemma (2004) came to this conclusion after Telemedicine was introduced in Telepsychiatry. Health care workers, who initially championed the technology, found that it threatened the therapeutic/doctor-patient relationship leading to Telemedicine being rejected and resisted.

Kijsanayotin, Pannarunothai and Speedie, (2009) studied user acceptance and the use of the health IT system introduced in community health centers in Thailand using the UTAUT model. They found that the health care workers in these community health centers exhibited a high degree of IT acceptance and use. The constructs found that influenced this IT acceptance was *performance expectancy*, *effort expectancy*, *social influence* and *voluntariness* while the IT use was predicted by previous IT experience, intention to use the system and other *facilitating conditions*. They concluded that health IT is well adopted by community health centers in Thailand.

Wills, El-Gayer and Bennet (2008) investigated the acceptance by health care workers and use of electronic medical records. The UTAUT was found to provide with reasonable accuracy the acceptance of the health care workers' intention to make use of the technology. The researchers found that *social influence* was a more important variable particularly among women than *performance and effort expectancy*. They concluded that it would be important to include these social constructs in the strategic implementation planning in order to improve acceptance and use of the technology. The next section concludes the chapter.

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4.6 CONCLUSION

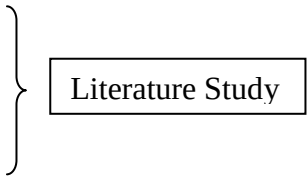
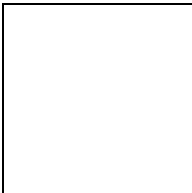
This chapter explored both the theoretical frameworks used in this research study as well as the health care research conducted previously making use of these two theoretical frameworks. The TAM is considered the golden standard of IS literature and has been validated in many settings with many different types of users. Since its inception in 1989 it has been extended and added to in order to improve the 40% rate it was able to accurately predict whether technology would be accepted. In health care research it has provided valuable insight into the health care workers' intent to accept and use new technology. Health care workers as a whole have been found to exhibit fundamental differences from other user groups making it necessary to incorporate additional factors into the model in order to improve the success rate. Some of the differences found included being more pragmatic about new technology as long as it was beneficial to the patient even if it was to the detriment of the user friendliness of the system. The autonomy of the health care workers when making decisions regarding patient care has also been put forward as the reason why social influence is not important when predicting if the health care worker will make use of the technology.

The UTAUT model was developed by Venkatesh *et al* in 2003 in order to combine 8 different models and improve the success rate of predicting if new technology would be accepted. This theory makes use of 4 constructs and 4 facilitating conditions which moderate the main constructs. In general it was found that men were more influenced by *performance expectancy* of new technology than women while women were influenced by the *effort expectancy* construct when deciding to make use of new technology. When testing the theory in health care research the results also suggested that health care workers were influenced by both *social influence* and *facilitating conditions* at various stages of technology adoption. Both *performance expectancy* and *effort expectancy* were found to be positively associated with behavioural intent although there is some controversy about the latter in the literature.

The results of these 2 models are important for managerial decision making as incorporating it into future technology projects will avoid the pitfalls of the past and improve the technology acceptance of the health care worker as well as the financial returns of IT projects. The next section explores the research methodology used in this research project.

Chapter 5

Research Design and Methodology



5.1 INTRODUCTION

The study investigates the technology acceptance and cor health care workers in the Eastern Cape Department of He different aspects of the research methodology will be discu design and paradigm; research approach; data collection the delimitation of the study as well as ethical considerations

The Positivistic and Interpretivistic paradigm approach in literature and is discussed in this chapter. The diff experimental quantitative research is highlighted with particu the main data gathering technique.

The research methodology for this particular study is justified Various methodologies were considered and the positivistic appropriate because of the quantitative nature of the data c instrument for this study was a questionnaire and the desig disadvantages as well as the testing of the questionnaire ar data collection and analysis is defined and the different tech according to the needs of the study. Finally the delimit considerations are explained in detail. The next section i research paradigms that can be used for research purposes.

5.1 Introduction
5.2 Research Design
5.2.1 Positivist and Phenomenologist Research Paradigm
5.2.2 Quantitative Research
5.2 Research Methodology
5.3 Research Instruments
5.4 Study Population
5.5 Data Analysis
5.6 Validation
5.7 Delimitation of Study
5.8 Ethics
5.10 Conclusion

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5.2 RESEARCH DESIGN

Research is defined as performing a methodological study in order to prove a hypothesis or answer a specific question (Shuttleworth and Martyn, 2008). The focus of Information Systems research considers the adoption of information technology as well as the contextual interaction resulting from the use of an artefact between human and machine (Gregor, 2006). Subsequently, Information Systems research “addresses questions of organisational action and social change” (Avgerou, 2000).

5.2.1 POSTIVIST AND PHENOMENOLOGIST RESEARCH PARADIGM

Research is directed by the underlying paradigm that guides how it will be conducted (Collis and Hussey, 2009). Making use of the philosophical assumptions that provide the foundation for research paradigms, the approach to social science research can differ from a positivist to a phenomenologist approach. Figure 8 is used to illustrate this paradigm.

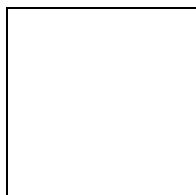


Figure 8: Typology of assumptions on a continuum of paradigms (Collis and Hussey, 2009)

Collis and Hussey (2009) argue that few researchers will make use of purely a Positivist or Phenomenologist (Interpretivist) approach within their research. They continue to reason that by making use of a combination from both approaches, researchers can take on a broader and often complementary view of the research problem or issue.

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Positivism is based on the foundation that the methods used to study the physical world can also be applied with modifications to study the social world. It therefore assumes that there is a single objective reality irrespective of people's individual values, attitudes or perspectives and that experience is the only sound basis for knowledge. Positivist reasoning therefore provides general laws that express empirical regularities and relationships and is considered an inductive scientific method (Sim and Wright, 2000).

Phenomenologist or Interpretive research assumes that as people interact with the world around them they will create and impose their own subjective meanings on it. It then attempts to understand phenomena through accessing the subjective meanings participants assign to these experiences. The end result of an Interpretivist approach is that the researcher cannot hold a value-neutral stance and will always influence the phenomena being studied to some degree (Walsham, 2002).

This research project leans strongly towards the Positivist approach as it views reality as a concrete process where the methods used to collect the data can be done objectively without the interference of the researcher's values, attitudes or perspectives. Once the data is collected statistical tests are used to identify trends and correlations between the different data points. The conclusions drawn from these tests are then used to generalize the results to similar study populations within set criteria. The next section discusses the characteristics of quantitative research with particular emphasis on survey research.

5.2.2 QUANTITATIVE RESEARCH

The research strategy adopted for this study is a quantitative approach making use of a survey research design. According to Hofstee (2006) quantitative research can be defined as the relationship between one thing (an independent variable) and another (a dependent or outcome variable) in a population. Leedy and Ormrod (2005), state that quantitative studies fall under the broad heading *descriptive quantitative research or experimental quantitative research*.

Descriptive quantitative research involves identifying the characteristics of an observed phenomenon or exploring possible correlations among two or more phenomena thereby examining the situation as it is. It does not involve changing or modifying the situation under investigation, nor is it intended to determine cause-and effect relationships (Leedy and Ormrod, 2005). According to Cooper and Schindler (2003) a descriptive study may be simple or complex

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and can be done in many settings. Leedy and Ormrod (2005) state that descriptive research designs and approaches involve observation studies, correlation research, development designs and survey research. All of these approaches yield quantitative information that can be summarized through statistical analyses. Experimental research designs will measure the difference before and after an intervention thereby establishing causality.

Furthermore Leedy and Ormrod (2005) state that quantitative research will always strive to find explanations and predictions that can be generalized to other persons and places. The intent is to establish, confirm, or validate relationships and to develop generalizations that contribute to theory. The quantitative approach is based on inductive reasoning and is characterised as repeatable and objective. Making use of specific and formulated research questions, patterns or trends are identified in the results of the study. These patterns then lead to general conclusions or theories.

Survey research involves acquiring information about one or more groups of people by asking questions and tabulating the answers. The information obtained can include opinions, characteristics, attitudes or previous experiences depending on what information is needed to answer the research questions. The aim of the survey is to learn about a large population by surveying a representative sample of that population, summarising the results with statistical indexes or graphical representations and then using this information to draw inferences about the particular population studied. The survey itself can take many forms e.g. face to face interviews, telephonic interviews or written questionnaires (Leedy and Ormrod, 2005). This study employed a survey questionnaire as the main data collection method. The questionnaire was compiled making use of existing published questionnaires (TAM and UTAUT) found in the literature. Additional information which was included, concentrated on computer literacy, management support and different modes of Telemedicine. The next section discusses the research methodology used in the study.

5.3 RESEARCH METHODOLOGY

This study investigated the technology acceptance and use of Telemedicine by health care workers in the Eastern Cape.

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The research paradigm applied is a positivistic research approach. The research methodology consisted of a literature review, the development of a questionnaire and the identification and selection of the study sample. After the data collection phase the data was analysed and critical success factors were identified and validated making use of industry experts. These steps are shown graphically in Figure 9.

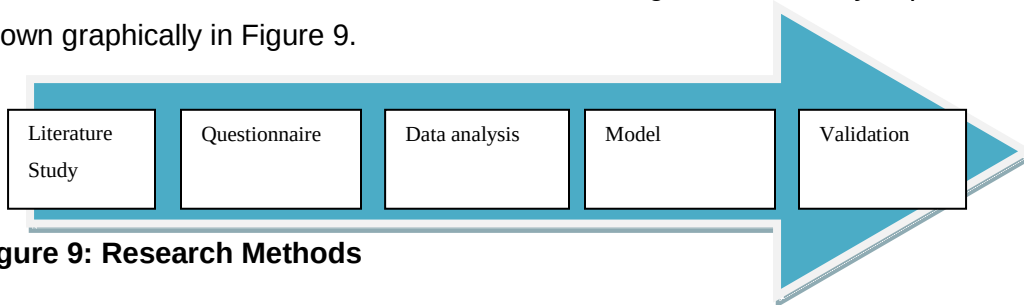


Figure 9: Research Methods

The aim of the literature review was to present an overview of recent research focusing on the adoption and continued use of an information system, in this case Telemedicine, in the health care system. The literature review is divided into 3 parts: An introduction to Telemedicine, Telemedicine in the developing world and Telemedicine in South Africa with specific emphasis on the Eastern Cape and a discussion of the theoretical framework of the TAM and UTAUT. The literature review was conducted making use of e-documents, journals, books, articles and reports.

After the completion of the literature review, the questionnaire used in the study was compiled making use of various existing questionnaires found in the literature. The content of the questionnaire focused on the importance of the acceptance and continued use of Telemedicine in the public health sector in the Eastern Cape. After the completion of the questionnaire the study sample was selected and the questionnaires distributed in hard copy to various sites around the province for completion, making use of the operational supervisor for Telemedicine in the Eastern Cape. The supervisor was trained and given guidelines on how to select participants for the study before he distributed the questionnaires.

Data analysis consisted of the collection and analysis of data. A statistical overview was compiled after which the findings of the survey were documented and critical success factors were identified. These critical success factors were validated by industry experts after which the conclusions and recommendations of the study were compiled (Leedy and Ormrod, 2005). The next section provides a description of the research instrument that was used to collect data in the study.

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5.4 RESEARCH INSTRUMENT

Questionnaires are used to elicit information directly from a group of people that is presumed to be representative of the larger study population (Leedy and Ormrod, 2005). Cooper and Schindler (2003) claim that the self-administered questionnaire has become part of modern living. Examples of self-administered questionnaires include service evaluations of hotels, restaurants and transportation providers. These questionnaires are delivered through the mail, fax, courier service or computer. Computer-delivered self-administered questionnaires make use of the Internet or organisational intranets to research their participants.

When making use of questionnaires as data tools the advantages include being both cost and time effective. This allows the researcher to increase the amount of people to be surveyed. The distribution of questionnaires via e-mail or mail costs far less than travelling to the various physical data collection sites, in this case Telemedicine sites around the Eastern Cape. Conducting individual interviews is also very time consuming for both the researcher and participants. The study participants have to agree to be interviewed in between their daily duties. The researcher has to travel to the various sites and wait for an appropriate time to conduct the interview. As Telemedicine is rolled out to mainly rural areas in the Eastern Cape the roads are not always considered roadworthy and telephonic connections are not reliable. Time and physical constraints would then mean that the researcher could only interview a very limited number of participants. The sample accessibility was increased through making use of a questionnaire as participants from all the different districts of the province could be reached making use of the Telemedicine operational supervisor who travelled to the various sites as part of his operational duties. The researcher would not have had the resources or time to survey participants in such a diverse geographical area.

Other advantages of a questionnaire include that confidentiality and anonymity of respondents can be guaranteed which allows for honest replies without the fear of peer reprisal or attempts to please the interviewer. The type of information obtained from a questionnaire is varied and includes factual, attitudinal, and interpretational or opinion based (Hofstee, 2006).

The obvious disadvantage of questionnaires is that it allows for limited interaction between the researcher and the participants. The format of a questionnaire also does not allow the researcher to digress from the set questions and limits the depth to which a participant can be probed. A well documented disadvantage is the poor response rate of answered questionnaires. If not enough questionnaires are returned it can weaken the results. Other

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considerations when using a questionnaire as a data collection tool include the complexity, time and resource commitment in the construction thereof and the subsequent analysis of the results. The responses of the participants in a study are also a reflection of their reading, writing and comprehension skills. A low literacy rate or misinterpretation of the questions can lead to incorrect data being obtained (Leedy and Ormrod, 2005).

The design of a questionnaire must be appropriate to the purpose it must achieve (Cooper and Schindler, 2003). There are two different formats that are typically used when designing a questionnaire. These include unstructured responses (or *open-ended response*) and structured responses (or *closed response*). Closed responses typically are categorised as dichotomous, multiple-choice, checklist, rating, or ranking response strategies. Closed-response questions are appropriate when there is a clear frame of reference, the participant's level of information is predictable and the researcher believes that the participant understands the topic.

During the literature review various questionnaires were identified as having the potential to answer the research questions posed in this study. The e-Health Readiness Assessment Tool for Healthcare Institutions in Developing Countries was developed by Khoja, Scott, Casebeer and Gilani (2007) to measure the preparedness of healthcare institutions or communities for the change brought forth by programs related to ICT. The tool was developed making use of an Action Research methodology and validated in Pakistan. The questionnaire consists of 4 different categories – core readiness; technological readiness; learning readiness and societal readiness. It consists of 50 questions and can be administered to both healthcare workers and administrators. The questionnaire identifies factors that need to be addressed in the planning of e-health programmes and serves as a monitoring and evaluation tool once technology has been implemented. The tool was not considered appropriate for this study as it focused on the readiness of the organisation as a whole to accept the new technology and not the individual acceptance and use of the technology.

The questionnaire used in this study was compiled making use of the published questionnaires as compiled by Davis (1989) and Venkatesh *et al* (2003). Both these two questionnaires have been published previously and extensively used in other studies to test the acceptance and use of new technology by users in different settings. The validity and rigour of these questionnaires have been proven in past literature and have been shown to be relevant to users making use of a diverse set of technologies in both a voluntary and mandatory environment (Venkatesh *et al*, 2003). Various researchers also proved that it can be applied to individuals of varied levels of

Critical Success Factors for User Acceptance of Telemedicine in South Africa

IT competency, gender, age and culture (Yarbrough and Smith, 2007; Lai and Li, 2005; McKoy, Everard and Jones, 2005). The sections covered by this questionnaire included characteristics of the participants, *perceived ease of use*, *perceived usefulness*, *performance expectancy*, *effort expectancy*, *social influence*, *facilitating conditions*, *attitude towards the system*, *behavioural intention*, and computer literacy.

A pilot study was conducted among a sample of 5 healthcare workers with similar characteristics as the study population in order to test the adequacy of the research instrument. After the pilot study was concluded the researcher found it necessary to include a section that focused specifically on the different modalities e.g. telephones, computers and cameras that can be used for Telemedicine. This was important as not all the participants were confident about the scope of Telemedicine. Through the inclusion of this section the use of the different modalities can be quantified and the most popular methods identified. The study population chosen for the study is explained in the next section.

5.5 STUDY POPULATION

Cooper and Schindler (2003) states that if individuals agree to participate in a study the researcher must be aware that they may not possess the knowledge being sought. Furthermore if participants are asked to report on events that they have not experienced personally, the purpose of the study must be assessed carefully. If the purpose is to learn what the participant understands to be the case of the events, it is legitimate to accept the answers given. Cooper and Schindler (2003) goes further by stating that, if the intent is to learn what the event or situation actually is, then it must be recognised that the participant is reporting second-hand data and the accuracy of the information deteriorates. In this study the health care workers all had previous experience of making use of Telemedicine and reported their individual intention of making use of the technology in future. The study participants were chosen making use of a convenience sampling method. This is a non-probability sampling technique where subjects are selected because of their convenient accessibility and proximity to the researcher. The advantages of this type of sampling are that it is fast, inexpensive, easy and the subjects are readily available (Castillo, 2009).

The study population of this research project was defined as any health care worker employed at an Eastern Cape Department of Health Telemedicine site around the province. Health care

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workers from the multidisciplinary team e.g. medical practitioners, nurses and clinical support staff that make use of Telemedicine during their clinical duties, were included in the study.

The questionnaires were distributed in a hardcopy format to participants. The questionnaire was delivered to and returned from the various sites via the operational supervisor. Attached to the questionnaire was a letter of explanation regarding the purpose of the study and ethical considerations. Seventy five questionnaires were distributed.

The data obtained can be placed into various categories according to both the TAM and UTAUT model. These include *ease of use*, *perceived usefulness*, *performance expectancy*, *effort expectancy*, *social influence* and *facilitating conditions*. A section on ICT literacy and the various modalities of Telemedicine was also included.

Different formats of questions and responses were included in the questionnaire to increase the variance of responses: yes/no, degree of agreement or disagreement (Likert scale), scale questions and rank order questions. In the next section the analysis of the data is discussed.

5.6 DATA ANALYSIS

According to Mouton (2004) all fieldwork culminates in the analysis and interpretation of some set of data, be it quantitative survey data, experimental recordings, historical and literary texts, qualitative transcripts or discursive data. Mouton (2004) further states that analysis involves 'breaking up' the data into manageable themes, patterns, trends and relationships. The aim of analysis is to understand the various constitutive elements of one's data through an inspection of the relationships between concepts, constructs or variables, and to see whether there are any patterns or trends that can be identified or isolated, or to establish themes in the data.

The data collection technique employed, that is the questionnaire, was aimed at gathering mainly quantitative data, as statistical analysis was necessary. In order to perform statistical analysis, the raw data gathered from the questionnaire was processed by making use of Statistical Package for the Social Sciences (SPSS).

Data was analyzed making use of SPSS. SPSS was selected for this purpose as it is an effective and efficient means of managing data (Gamble, 2001). SPSS is a statistical analysis package that allows the researcher to undertake a wide range of statistical analyses relatively easily (Brownlow, Cozens, Hinton and McMurray, 2004).

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Illustrative, descriptive and analytical statistics were obtained. Illustrative and descriptive statistics are represented as location (mean, median), dispersion (range, percentile) and statistical graphics (bar chart, box plot) while the chi-square test was used to analyze the data (Grant and Warren, 2001).

The chi-square statistical test is commonly used to compare frequencies or proportions. It is a statistical test used to determine if observed data deviate from those expected under a particular hypothesis. Typically the hypothesis tested is whether or not two samples are different enough in a particular characteristic to be considered members of different populations. The chi-square test always tests the null hypothesis, which states that there is no significant difference between the expected and observed result. The test is also a measure of fit or “goodness of fit” between data. The researcher can then either accept or reject the null hypothesis after comparing the value of the chi-square to a probability distribution. The test requires that numerical values be used, not percentages or ratios (Grant and Warren, 2001).

Validity and reliability of the data was ensured making use of a pilot study and data cleaning methods. To ensure the validity of the questionnaire a pilot study was conducted two weeks prior to the main study. The only change made to the questionnaire was the additional section regarding the different modalities of Telemedicine. In general the questions were found to be clear and user friendly. Reliability was ensured through the following:

- Guidelines as set out in the proposal were followed while developing, distributing and analyzing the questionnaire with the aim of improving standardization;
- Frequent cross checks were done to improve the accountability of data entering;
- A pilot study was conducted to ensure reproducibility of the questionnaire;
- Definitions for all variables were provided to ensure repeatability of the questionnaire and
- Questionnaires not returned within the allotted time period were followed up to minimize bias.

In the next section the process of validation of the Critical Success Factors are discussed.

5.7 VALIDATION

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A data analysis will be conducted to identify statistically significant relationships in the data. From these relationships trends will be identified which can be used as recommendations to improve the acceptance and use of technology among health care workers. These recommendations will be given to a panel of 4 experts in Telemedicine and technology acceptance in general in order to validate the findings of this study. Once feedback from the experts has been received it will be incorporated into the final recommendations and conclusions of the research project. In the next section the delimitations of the study are discussed.

5.8 DELIMITATION OF STUDY

The study was conducted at 6 hospitals and 25 clinics sites in the Eastern Cape where Telemedicine had been introduced in the last 5 years. A minimum of 75 health care workers from the multidisciplinary team were asked to participate in the study by completing the questionnaire. Exclusion criteria for this study included technology issues associated with Telemedicine as well as budget and other financial constraints faced by the sponsor of the technology. Telemedicine used in the private sector was also not considered in the study. Inclusion criteria considered Telemedicine used for clinical practices as well as training in the public health sector. Included in the training will be the issue of computer literacy of the participants of the study. In the next section the ethical considerations of the study are provided.

5.9 ETHICS

Ethical considerations in research reflect important moral concerns about the practice of responsible behaviours in society. Therefore it ensures that no physical or mental harm is done to participants that during the research. Examples of unethical activities in research would include violating non-disclosure agreements, breaking respondent confidentiality, misrepresenting results, deceiving people, and avoiding legal liability (Cooper and Schindler, 2003).

Sim and Wright (2002) state that a researcher conducting research in health care should consider the following factors relating to ethics: informed consent; privacy and confidentiality; anonymity; deception; risk of harm; and, exploitation of respondents.

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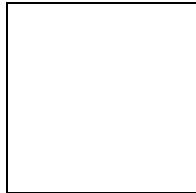
This research project did comply with the ethical issues considered above. The questionnaire was completed anonymously by the study participants ensuring privacy and confidentiality. Participants in this study were assured that the information obtained would not be made available to anyone not directly involved in the study and formal consent was obtained from the East London Hospital Complex and University of Fort Hare before the study was conducted. Study participants also received a covering letter explaining the purpose of the study and informing them that participation in the study was voluntary. In the next section a brief conclusion of the chapter is provided.

5.10 CONCLUSION

In this chapter the research design which was applied during this research project was discussed. The research paradigm chosen was a positivistic approach making use of a quantitative research method. A survey research design was used to collect data. The questionnaire was partly compiled making use of the TAM and UTAUT questionnaires that had been published previously in literature and validated during a pilot study. The study population consisted of health care workers employed by the Eastern Cape Department of Health working at various Telemedicine sites in the province. The data collection and analysis techniques were also provided. For this study SPSS was used to analyse data. Validation of the results drawn from the data analysed was completed by distributing the conclusions to a panel of 4 experts for discussion and recommendations. The ethical considerations taken into account during this study project were also provided. The data categories collected as well as the results from the data analysis are discussed and presented in the next chapter.

Chapter 6

Empirical Findings



6.1 INTRODUCTION

A detailed discussion of Telemedicine in developing countries with specific focus on South Africa as well as the two theories employed within this study, namely TAM and UTAUT, was put forward in the literature chapters. Additionally the research methods employed during this study have been described. The empirical analysis and results has not been discussed thus far.

The different sections within this chapter can be divided into sections based on the data obtained (response rate and demographics) as well as the research questions posed earlier and addressed to each research question. The results of the data collected is reported making use of different statistical tests, percentages and non-parametric tests and illustrated making use of bar graphs and tables. The data reported will be used in the analysis and discussion. The first two sections detail the general characteristics of the population.

6.2 RESPONSE RATE

A total of 75 questionnaires were distributed to public sector and private Telemedicine sites in the Eastern Cape. After a 2 week period the response rate representing a 76% return rate.

Literature Study

6.1 Introduction
6.2 Response rate
6.3 Socio-demographic characteristics of the participants
6.4 Telemedicine modalities
6.5 Facilitating conditions
6.6 Management support
6.7 Computer literacy
6.8 Conclusion

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The findings can be grouped into the following categories: General information of participants; computer literacy; modalities used for Telemedicine; and the factors influencing the acceptance and use of Telemedicine among the study population. These factors include *perceived usefulness; perceived ease of use; performance expectancy; effort expectancy; social influence; facilitating conditions; attitude towards the system and behavioural intent*. The next section will report the socio-demographic characteristics of the study population.

6.3 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

The study population consisted of 49 females (86%) and 8 males (14%). The majority of the participants were of South African nationality (94,7%). The age of the participants are depicted in Table 7 below. A third of the participants were younger than 30 years, twelve percent aged between 30 and 40 years and half the participants were older than 40 years.

Table 7: Age of participants

		Frequency (N=57)	Percent (%)
Valid	< 30 years	21	36.8
	30 - 40 years	7	12.3
	41 - 50 years	19	33.3
	> 50 years	10	17.5
	Total	57	100.0

The highest qualifications obtained by the participants can be divided as follow:

- 22,8% completed grade 12;
- 29,8% completed a nursing diploma;
- 33,3% of the participants obtained a degree and
- 14% indicated that they had not obtained a Grade 12 qualification.

Only 1 doctor (1,8%) and 1 pharmacist (1,8%) were part of the study population. The majority of the study population consisted of allied health professionals (43,9%) who included physiotherapists, radiographers, speech and audiology therapists and dieticians. Nurses made

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up 29,8% of the study population. The category marked *Other* consisted of dental assistants and student nurses who completed the questionnaire (22,8%).

The study participants indicated that 43,9% worked in a urban setting and 56,2% in a rural area. Table 8 provides a breakdown of the different work places where the study participants indicated they are stationed. Most of the participants (40,4%) worked in a clinic followed by 22,8% who worked in a secondary hospital, regional hospital (17,5%), district hospital (15,8%) and community centers (3,5%).

Table 8: Places of work

		Frequency (N=57)	Percent (%)
Valid	Clinic	23	40.4
	Community health center	2	3.5
	District hospital	9	15.8
	Regional hospital	10	17.5
	Secondary hospital	13	22.8
	Total	57	100.0

Table 9 illustrates the frequency with which the participants used Telemedicine. A third of the study population indicated that they do not use the system, 10,5% indicated that they use it at least once a month or week respectively and 42,1% indicated that they make use of the system on a daily basis.

Table 9: Frequency of using Telemedicine

Frequency	Percentage
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Critical Success Factors for User Acceptance of Telemedicine in South Africa

		(n=57)	(%)
Valid	None	19	33.3
	Monthly	6	10.5
	Weekly	6	10.5
	Daily	24	42.1
	Total	55	96.5

There were 43,8% of the participants that considered themselves confident about their knowledge of Telemedicine while 31,6% indicated they were somewhat knowledgeable about the technology and 21,8% considered themselves not knowledgeable. The next section provides a list of the different types of technology that can be used for Telemedicine purposes as well as the frequency with which these technologies are used.

6.4 TELEMEDICINE MODALITIES

Telemedicine can make use of different types of technology. These modalities include SMS/MMS, telephonic conversations, e-mail with or without photographs and the Telemedicine unit. The following table illustrates the percentages of the different types of modalities that can be used. Most of the participants indicated that they never use the Telemedicine unit (66,7%) followed by e-mail (61,4%), SMS/MMS (45,6%) and telephonic conversations (36,8%). The modality used most often was telephonic conversations (43,9%), SMS/MMS (24,6%) while only 8,8% of the study population used the Telemedicine system on a daily basis.

Table 10: Frequencies of modalities used

	Never (%)	Seldom (%)	Often (%)	Daily (%)
SMS/MMS	45,6	12,3	17,5	24,6
Telephonic conversation	36,8	3,5	15,8	43,9
E-mail	61,4	10,5	17,5	10,5
E-mail with photographs	59,6	19,3	12,3	8,8

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Telemedicine unit	66,7	8,8	15,8	8,8
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6.5 FACILITATING CONDITIONS INFLUENCING ACCEPTANCE AND USE OF TECHNOLOGY

There are different conditions which will influence the acceptance and use of technology as pointed out in the TAM and UTAUT models. These conditions include *perceived usefulness, perceived ease of use, performance expectancy, effort expectancy, social influence, facilitating conditions, attitude towards the system and behavioural intent*.

In this section, for each of these conditions the results of the study conducted are discussed. Statistical reporting will include the percentage, mean and mode for each condition as well as the statistically significant indicators within each condition. These results will address the first research question: What are the facilitating conditions necessary for the adoption and continued use of Telemedicine in the Eastern Cape?

6.5.1 PERCEIVED USEFULNESS

The mean for this category is 2,95 with a median of 3 (agree). The participants perceived Telemedicine to be a useful technology. The average for the different qualities of Telemedicine was recorded as follow:

- Quality improvement 79,0%
- Increased control over work 75,4%
- Improved efficiency 73,6%
- Supportive of critical aspects 71,9%
- Increased productivity 77,2%
- Increased efficiency 80,7%
- Easier to do job 79,0%

Overall participants perceived the technology to be very useful in health care (82,5%).

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The majority (80%) of the questions in this category were found to be statistically significant for gender. The percentages for females agreeing with the statements are consistently higher than those of the males leading to the conclusion that females are more likely to accept and use technology because of *perceived usefulness*.

Age and 'Using Telemedicine improves the quality of the work I do' tested statistically significant ($X^2=18,253$; $p<0,05$). The age group younger than 30 years of age provided the highest percentage of those that disagreed with the statement (28,6%) followed by the 40-50 year age group (26,3%) and the 30-40 year age group (14,3%). The participants older than 50 years of age agreed with the statement that Telemedicine would improve the quality of their work 100%.

The highest qualification obtained tested statistically significant for 80% of the questions in the *perceived usefulness* category. The participants who did not obtain a grade 12 qualification consistently indicated that the technology would be useful in their daily duties (95,13%). The health care workers with a degree did not perceive Telemedicine as useful to improving the quality of (62,5%) and control over work (62,5%) while those with a diploma did not perceive the technology to increase the speed with which they could accomplish tasks as well as productivity (57,9% respectively). The group with a degree was not as positive about the technology being able to increase job performance (62,5%) or to making it easier to accomplish the job (62,5%) while they agreed with the diploma group that the technology did not allow them to accomplish more work than when not using the technology (57,2% and 57,9% respectively). Overall the group with a grade 12 qualification scored the lowest percentage when asked if Telemedicine is useful in their job (66,5%). The overall impression of the technology and *perceived usefulness* is positive (82,5%) with the only category scoring an overall total of less than 70% being "using Telemedicine allows me to accomplish more work" than would otherwise be possible.

Place of work was statistically significant for 2 of the statements in this category. The two questions were "Using Telemedicine gives me greater control over my work" ($X^2=26,882$; $p<0,05$) and "Overall, I find Telemedicine useful in my job" ($X^2=21,884$; $p<0,05$). All the health care workers placed in community health centers (100,0%) indicated that they perceived Telemedicine as useful. This group was followed by those working in clinics (87,0% and

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96,7%); district hospitals (88,9% and 77,7%); regional hospitals (60,0% and 90,0%) and secondary hospitals (53,9% and 53,9%).

The frequency with which health care workers make use of Telemedicine was also found to be statistically significant ($X^2=18,428$; $p<0,05$). The participants that made use of Telemedicine infrequently supported Telemedicine as being useful 75,8%, while those that made use of Telemedicine frequently perceived the technology to be useful 87,4% of the time.

Perceived knowledge of Telemedicine and *perceived usefulness* tested statistically significant ($X^2=19,521$; $p<0,05$). The health care workers that considered themselves knowledgeable about Telemedicine consistently provided higher percentages (mean = 97,4%) than those who did not perceive themselves knowledgeable about the technology (mean = 61,95%) when asked if they perceived Telemedicine as useful.

6.5.2 PERCEIVED EASE OF USE

The mean for this category is 2,54 and the median 3 (agree). Overall 63,7% of the participants indicated that they perceived the Telemedicine system easy to use. Learning how to use the system was more positive as 69% indicated it was easy to learn how to use the system while 54,4% indicated that it took considerable effort to become skilful in making use of the system. Once in operation half of the participants (49,3%) found the Telemedicine unit cumbersome to use or required much mental effort to operate (47,3%). A third (36,9%) found it frustrating to use the system during their daily duties. Almost the same percentages (33,4%) indicated that they perceived the unit as inflexible and rigid to use.

Gender and perceived ease of use tested statistically significant for 6 of the questions in this category ($p<0.005$). Female health care workers perceived Telemedicine easy to operate and use. They found it easier to learn how to use the system (70,9%) than their male counterparts (62,5%) and less frustrating to operate the system (34,7% vs 50,0%). They also found the system to be more user friendly (31,1%) than their male colleagues (50,0%).

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Qualification tested statistically significant for two questions:

- I find it cumbersome to use the Telemedicine system ($X^2=17,830$; $p<0,05$)
 - The health care workers with a grade 12 qualification found the system cumbersome to use (80,0%) followed by those with a diploma qualification (68,0%) and those without a grade 12 qualification (42,9%). A third of health care workers with a degree qualification found the system cumbersome to use.
- I find it takes a lot of effort to become skilful at using the Telemedicine system ($X^2=26,853$; $p<0,05$)
 - Most of the health care workers found that it was difficult to learn how to use the system. Those with a diploma qualification (76,4%) and grade 12 qualification (69,2%) were the largest groups with degree qualifications following at 22,0%.

Facilities in the rural areas found it cumbersome to make use of the Telemedicine system (69,5%) while those in the urban areas only recorded a 50,0% difficulty rate ($X^2=15,287$; $p<0,05$). Health care workers also found that it was difficult to learn how to use the system (77,8%) while 41,7% of their counterparts in the urban areas had the same difficulties ($X^2=12,616$; $p<0,05$).

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The different facilities tested statistically significant for the following 4 questions:

- Learning to operate the Telemedicine unit is easy for me ($X^2=21,269$; $p<0,05$).
 - The health care workers working in community health centers (100,0%) found it easiest to learn how to operate the system. This group is followed by the district hospital (87,5%), regional hospital (80,0%) and clinics (73,9%). Staff working in secondary hospitals found it difficult to learn how to make use of the system (38,5%).
- It is easy for me to remember how to perform tasks using the Telemedicine system ($X^2=26,510$; $p<0,05$).
 - All the categories with the exception of the health care workers in secondary hospitals (31,7%) found it easy to perform tasks with the Telemedicine system. All the health care workers in the community health centers and district hospitals (100,0%) agreed with the statement.
- Interacting with the Telemedicine system requires a lot of my mental effort ($X^2=23,680$; $p<0,05$)

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- The health care workers in secondary hospitals disagreed with this statement (33,3%) followed by those working in clinics (47,8%), community health centers (50,0%), district hospitals (55,0%) and regional hospitals (66,0%).
- My interaction with the Telemedicine system is clear and understandable ($X^2=28,683$; $p<0,05$)
 - Most of the categories agreed with this statement with those at regional hospitals and community centers in total agreement (100,0%). Health care workers at secondary hospitals disagreed with the statement (30,8%).

The health care workers who make use of the Telemedicine system frequently reported that they did not find it difficult to make use of the system (55,0%) while those who used the system infrequently had a slightly lower percentage (46,0%) ($X^2=17,363$; $p<0,05$).

The health care workers who considered themselves knowledgeable about Telemedicine reported that they did not find it difficult to use the Telemedicine system (84,5%) ($X^2=17,019$; $p<0,05$) while those with less or no knowledge had a slightly lower percentage at 61,5% ($X^2=16,888$; $p<0,05$).

6.5.3 PERFORMANCE EXPECTANCY

The mean for this category is 2,87 while the mode is 3 (agree). Participants believed that the technology would increase their productivity. Those who found Telemedicine useful during their daily jobs were 80,7% while 75,4% perceived the technology as making them more efficient. Telemedicine was perceived to increase productivity by 67,2%. Only a third (33,4%) indicated that they would receive financial incentives in the form of a promotion if they made use of the technology.

A statistical significant difference was found for *performance expectancy* when measured against profession as well as where the facility was located. All of the participants with a grade 12 and diploma qualification agreed that Telemedicine would be useful in their job while 72% of participants with a degree qualification indicated the same ($X^2=19,647$; $p<0,05$). The majority of participants with at least a grade12 qualification indicated that they perceived Telemedicine as decreasing activity time with the lowest percentage being 66,5% in the diploma group. Those

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that did not obtain a grade 12 qualification agreed with the statement but with a much lower percentage (52,5%) ($X^2=18,002$; $p<0,05$).

The type of facility where participants work found Telemedicine to be useful in their daily activities as follow ($X^2=29,629$; $p<0,05$):

- Clinic 95%;
- Community health center 100%;
- District hospital 88,9%;
- Regional hospital 88,9% and
- Secondary hospital 54%.

Those participants working in a clinic, community health centre or district hospital agreed that Telemedicine could decrease working time by 94%, 100% and 77% respectively. Participants working in a regional or secondary hospital disagreed with this statement 44% and 36% respectively ($X^2=23,310$; $p<0,05$).

The prospect of career advancement was statistically significant for age ($X^2=17,960$; $p<0,05$). Participants younger than 40 years of age did not agree with this statement (mean=83,2%) while those older than 40 years of age agreed with the statement (mean=58,3%).

6.5.4 EFFORT EXPECTANCY

The mean of this category was 2,92 with a mode of 3 (agree). The majority of the participants indicated that they found it easy to learn how to use the system as well as to operate it while in use. Sixty nine percent indicated that they found it easy to learn how to use the system while 71,2% responded that the system was easy to use once they had learned how to use it.

Interaction with the Telemedicine system was statistically significant for the area in which the facility is located, place of work of the study population and the general knowledge of Telemedicine of the health care workers.

Most of the health care workers included in this study indicated that their interactions with the Telemedicine system were clear and understandable ($X^2=14,415$; $p<0,05$). Those working in rural areas (81,4%) agreed with the statement followed by the health care workers in urban areas (69,7%). Health care workers in both the urban (72%) and rural (81,5%) areas indicated

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that they felt it was easy for them to become skilful in making use of Telemedicine ($X^2=21,279$; $p<0,05$).

The following graph indicates the percentages of health care workers placed at different facilities and who agreed with the statement ($X^2=22,543$; $p<0,05$).

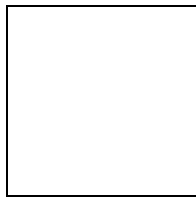


Figure 10: My Interactions with the Telemedicine system are clear and understandable.

“Learning to operate the Telemedicine system is easy for me” was statistically significant only for the facility in which the participants worked ($X^2=25,926$; $p<0,05$). Health care workers at clinics agreed with the statement 74%, community health centers as well as district hospitals 100% respectively, regional hospitals 80% and secondary hospitals 23,1%.

Knowledge of Telemedicine tested statistically significant for 3 questions in this category. These include interaction with the Telemedicine system is clear and understandable ($X^2=21,883$; $p<0,05$); ease of becoming skilful with the system ($X^2=17,423$; $p<0,05$) and ease of using the system ($X^2=25,376$; $p<0,05$).

The majority of the participants who considered themselves knowledgeable regarding Telemedicine indicated that they could use the technology (mean=85,85%) while those who did not consider themselves knowledgeable regarding the technology felt that their interactions with the Telemedicine system were not clear and understandable (mean=52,7%).

Participants who indicated they were not knowledgeable regarding Telemedicine agreed that it was easy for them to become skilful to make use of Telemedicine (mean=52,7%) as did those that perceived themselves knowledgeable regarding the technology (mean=87,85%). This is supported by the next statement that it is easy to use the Telemedicine system by those that

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are not technology knowledgeable (mean=54,15%), those that perceive themselves knowledgeable regarding Telemedicine agreed with the statement 87,8%.

6.5.5 SOCIAL INFLUENCE

The mean for this category is 2,69 while the median is 3 (agree). A third of the study participants (33,1%) indicated that people who influence their decision making regarding making use of the technology would be able to do so while 66,7% indicated that people who are important to them would be able to accomplish the same.

Gender tested statistically significant for important people ($X^2=28,267$; $p<0,05$) being able to positively influence the use of Telemedicine. More females (67,3%) than males (50%) were susceptible to being influenced to use Telemedicine because people important to them wanted them to do so.

A positive correlation was also found between people influencing health care workers to use Telemedicine and the place of work ($X^2=25,713$; $p<0,05$). Additionally a positive correlation was found between those health care workers placed in clinics (65,3%), community health centres (100%), district hospitals (66,7%) and regional hospitals (79,00%) while those working in the secondary hospital disagreed with the statement (69,3%).

Perceived knowledge of Telemedicine tested statistically significant for all 4 of the questions in this category. Health care workers who considered themselves knowledgeable of Telemedicine agreed with the statement that outside people would influence their behaviour to use the technology (mean = 79,15%) while only 50% of those that did not consider themselves knowledgeable agreed with the statement ($X^2=19,047$; $p<0,05$).

6.5.6 FACILITATING CONDITIONS

Facilitating conditions include resource availability such as technical assistance, knowledge of the system and compatibility with other systems already in use. The mean for this category is 2,54 with a median of 3 (agree). Half of the participants (54,4%) indicated that they thought they did have the resources necessary to make use of Telemedicine. The majority of the health care workers indicated that they had the knowledge necessary to operate the system (71,9%).

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Two thirds (64,9%) indicated that they did have access to technical assistance if necessary while 40,3% indicated that the technology is not compatible with the systems already in use at their health care facility.

The resources necessary to make use of Telemedicine tested statistically significant for gender, age, qualification and knowledge of Telemedicine. The majority of men indicated that they did feel they had the resources available to make use of Telemedicine (87,5%) while only half of women (50%) agreed with the statement ($X^2=14,902$; $p<0,05$). The age group younger than 40 years of age had an average of 59,5% that agreed with the statement while the age group older than 40 years provided an average of 52,2% for those that agreed with the statement ($X^2=18,039$; $p<0,05$). Qualification provided the following positive correlation with the statement ($X^2=18,107$; $p<0,05$); Grade 12 qualification (75,0%); Diploma (54,0%); Degree (47,0%) and less than a grade 12 qualification (50,0%).

Less women (68,4%) than men (87,5%) felt that they had the knowledge necessary to make use of Telemedicine ($X^2=10,912$; $p<0,05$). The health care workers that considered themselves knowledgeable regarding the technology were far less confident about technical assistance (57,0%) than the group that perceived themselves knowledgeable (81,6%) ($X^2=19,566$; $p<0,05$).

6.5.7 ATTITUDE TOWARDS THE SYSTEM

The mean for this category is 2,88 with the mode set at 3 (agree). A third of the participants (31,6%) indicated that they are fearful of using the system in the event that they make a mistake while 40,3% indicated that they felt apprehensive about using the system. The majority of the health care workers reported that they enjoyed working with the system (84,2%) while 94,7% thought it was a good idea to make use of Telemedicine to improve productivity.

“Telemedicine is a good idea to use to improve service delivery” was statistically significant for age ($X^2=14,445$; $p<0,05$) and profession ($X^2=123,129$; $p<0,05$). The majority of both the age and professions categories agreed with the above statement. Only a small portion (14,0%) of those younger than 30 years of age disagreed with the statement. Among the allied health professionals 8,0% indicated that they disagreed with the statement.

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“Work is being made interesting by Telemedicine” was statistically significant for age ($X^2=21,552$; $p<0,05$), profession ($X^2=14,886$; $p<0,05$) and area of facility ($X^2=11,130$; $p<0,05$). Of the health care workers younger than 30 years of age 33,0% disagreed with the statement while those older than 50 years of age indicated that 10,0% disagreed with the statement. The only category of professionals that disagreed with the statement was the allied health professionals (24,0%) while those working in the urban area (20,0%) and rural area (3,7%) disagreed with the statement.

Feeling apprehension when making use of the system tested statistically significant for qualification ($X^2=26,756$; $p<0,05$), area of facility ($X^2=24,485$; $p<0,05$), place of work ($X^2=22,163$; $p<0,05$) and knowledge of Telemedicine ($X^2=17,648$; $p<0,05$). The majority of health care workers agreed with the statement that making use of the technology make them feel apprehensive. The largest percentage was found among those with a grade 12 qualification (84,6%) followed by those with a diploma (82,3%) and those without a grade 12 qualification (77,0%). Health care workers with a degree qualification made up the smallest portion with only 15,8% indicating that they felt apprehensive about using the technology. The participants working in the rural areas had the most anxiety regarding using the system with 81,4% indicating they felt apprehensive about the system followed by those working in the urban area (44,4%). The place of work also influenced the apprehension level of the participants with those working in clinics at 78,2% followed by district hospitals (55,5%) and community health centers (50,0%). Less than half of the health care workers working at the secondary hospital felt apprehensive about using Telemedicine (46,2%) followed by the regional hospital (40,0%).

6.5.8 BEHAVIOURAL INTENT

The mean for this category is 2,88 with the mode being recorded as 3 (agree). Most of the participants indicated favourably that they would be making use of the system in the next 12 months. A total of 70,2% indicated that they intended and predicted that they would make use of Telemedicine in the next 12 months while 78,9% indicated they planned to make use of the technology during the next 12 months.

Behavioural intent was statistically significant for both the predicted ($X^2=16,139$; $p<0,05$) and planned ($X^2=22,163$; $p<0,05$) used of Telemedicine during the next 12 months as well as

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gender. More females than males participants predicted (75,1% vs 50%) and planned (83,4% vs. 62,5%) to make use of the technology.

6.6 MANAGERIAL SUPPORT

The second research question investigates what effect management support has on the decision to make use of Telemedicine. The support of the Department of Health tested significant with all 3 categories of behavioural intent. These include intent to use the technology in the next 12 months ($X^2=25,757$; $p<0,05$), planning to use the technology during the next 12 months ($X^2=28,691$; $p<0,05$), and predictive intent to use the technology during the next 12 months ($X^2=21,875$; $p<0,05$).

The majority of the participants who intended to make use of Telemedicine during the next 12 months agreed that the Department of Health had supported the installation and use of the technology ($n=31$) while 9 participants indicated that they would not be making use of the technology even though the Department had been supportive.

A similar result was found for the participants who predicted that they would make use of the technology and agreed that the Department of Health had supported the technology ($n = 30$) and those who predicted they would not make use of the technology despite this support ($n = 10$). More than half ($n = 36$) of the participants indicated that they planned to make use of the technology and perceived the Department of Health as supportive of the technology.

Half of the participants indicated that they perceived the local hospital management to be supportive of the technology and intended ($n = 25$), predicted ($n = 25$) and planned ($n = 31$) to make use of Telemedicine in the next 12 months. Managerial support at the hospital level was significant for both planning to use the technology during the next 12 months ($X^2=28,265$; $p<0,05$) and predictive intent to use the technology during the next 12 months ($X^2=19,051$; $p<0,05$).

The majority of the participants indicated that they had the necessary resources available to make use of Telemedicine. These resources would have to be authorised by the provincial or hospital management; thus indicating managerial support. Only planned use of Telemedicine in the next 12 months tested statistically significant ($X^2=20,054$; $p<0,05$). A total of 19 participants

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indicated that they did not have the necessary resources available but still planned to make use of the technology, while 25 indicated that they planned to make use of Telemedicine and did have the necessary resources available.

Support both from the management of the hospital ($X^2=22,584$; $p<0,05$) and Department of Health ($X^2=30,332$; $p<0,05$) was found to be statistically significant for the level of knowledge ability of Telemedicine. Those who did not consider themselves knowledgeable about Telemedicine agreed that the hospital management and Department of Health supported the use of Telemedicine 31,6% and 47,0% respectively. Those who considered themselves knowledgeable about Telemedicine agreed that the hospital management and Department of Health supported the use of Telemedicine 80,5% and 97,5% respectively. The next section deals with computer literacy among the study participants.

6.7 COMPUTER LITERACY

The third research questions consider what role previous exposure to Information Technology has on the user in helping to predict the likelihood of Telemedicine being adopted and used. In this section computer literacy, frequency of computer use and computer training is reported and tested to answer this question.

6.7.1 PC LITERACY

The computer literacy among the study population is self reported as 73,7%. Those that considered themselves computer illiterate totalled 27,3%. Different tasks that can be performed making use of IT were investigated. Most of the participants indicated that they make use of e-mail (59,6%) and a digital camera (64,9%) for either personal or work use. The majority also made use of either Microsoft Word (61,4%) or Excel (54,4%) for work purposes. Table 4 provides a breakdown of the different tasks and accessories that can be used with a computer.

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Table 11: Computer literacy

Do you make use of....		Frequency (n=57)	Percentage (%)
E-mail	Yes	34	59,6
	No	23	40,4
A digital camera	Yes	37	64,9
	No	20	35,1
Microsoft Word	Yes	35	61,4
	No	22	38,6
Microsoft Excel	Yes	31	54,4
	No	26	45,6

The perceived level of computer literacy tested statistically significant for qualification ($X^2=16,781$; $p<0,05$), profession ($X^2=9,614$; $p<0,05$), area of facility ($X^2=17,286$; $p<0,05$) and place of work ($X^2=17,086$; $p<0,05$). None of the participants with a degree qualification considered themselves computer illiterate. Those without a grade 12 qualification were the largest computer illiterate group (40,0%) followed by those with a diploma (33,3%) and a grade 12 qualification (26,7%).

Among the different professions, nurses were the largest computer illiterate group (46,7%) followed by the allied health professionals with 13,3%. No doctor or pharmacist considered themselves computer illiterate.

In the rural areas the majority of health care workers considered themselves computer illiterate (93,3%) with only 6,7% of their counterparts in the urban areas indicating that they were computer illiterate. The place of work provided the following percentages regarding perceived computer illiteracy: clinics (80,0%) and district hospitals (20,0%). No health care worker at a community health center, regional or secondary hospital indicated that they were computer illiterate.

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Computer literacy was tested against behavioural intention to use Telemedicine within the next 12 months. It did not test statistically significant for the categories of planned, predicted or intended use of the technology. The majority of the participants who considered themselves computer literate intended to make use of the technology ($n = 31$) versus a mean of 10 who did not intend to make use of Telemedicine during the next 12 months. More among those who did not consider themselves computer literate intended to make use of the technology ($n = 9$; $n = 6$).

A similar result was found for predicted intention to use the technology. The majority of the participants who considered themselves computer literate predicted they would make use of the technology ($n = 30$) versus $n = 11$ that did not plan to make use of Telemedicine during the next 12 months. The computer illiterate group represented a mean of 10 that predicted they would make use of Telemedicine during the next 12 months with 5 declining the option.

The computer literate participants who planned to make use of Telemedicine represented a mean of 33 while those who did not plan to make use of Telemedicine represented a mean of 8. More among those who did not consider themselves computer literate planned to make use of the technology ($n = 12$; $n = 3$).

6.7.2 FREQUENCY OF PC USE

More than half of the participants indicated that they make use of a computer on a daily basis (57,9%). Those who used it on a weekly or monthly basis was 12,3% and 3,5% respectively with 24,6% indicating that they never use a computer as part of their daily duties. Almost two thirds (64,9%) of the participants did however indicate that they used a computer for personal use.

The following graph illustrates the different qualification categories that make use of a computer for both private and official use. The participants with degrees provide both the highest percentages for computer use in official and private capacity (55,9% and 51,4% respectively) while the those without a grade 12 qualification provided the lowest percentages (5,9% and 5,4% respectively). Qualification and the use of a computer for both private and work purposes was found to be statistically significant ($X^2=21,666$; $p<0,05$ and $X^2=17,634$; $p<0,05$).

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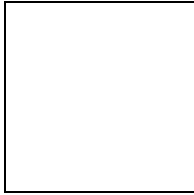


Figure 11: Educational level and frequency of computer use

All of the doctors and pharmacists surveyed made use of a computer for both official and private use while only 23,5% and 16,2% of nurses accounted for the same categories. The graph below illustrates all the different categories of professionals.

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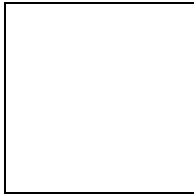


Figure 12: Profession and computer use for official and private use

Health care professionals working in the rural areas indicated that the majority did not use computers for either official (82,6%) or private use (95,0%). Those living in urban areas only accounted for not using computers for official use 17,4% and private use 5,0%.

The lowest percentage for health care workers making use of a computer for official or private use was found in the community health centers (5,9% and 5,4% respectively) with the highest percentages being found in the secondary hospital (32,4% and 35,1%) respectively. The percentages for the different places of work are shown in the graph below.

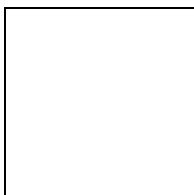


Figure 13: Facility of work and computer use for official and private use

Those who use computers frequently were much more likely to make use of computers for official use (91,2%) while the same holds true for the use of a computer for private use (89,2%).

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The frequency of computer use was tested against behavioural intention to use Telemedicine within the next 12 months. It did not test statistically significant for the categories of planned, predicted or intended use of the technology. Half of the study population that used a computer frequently indicated that they intended to make use of Telemedicine in the next 12 months ($n = 28$). A similar result is found for those who predicted they would make use of Telemedicine in the next 12 months ($n = 28$) while even more of the participants who make use of a computer frequently planned to make use of Telemedicine in the next 12 months.

6.7.3 COMPUTER TRAINING

Formal computer training has been received by 40,4% of the study participants. More female participants (56,3%) than male participants in this study had not received any formal computer training ($X^2=4,642$; $p<0,05$). Participants older than 40 years were more likely not to have received any formal training (61,8%) than those younger than 40 years of age (38,2%). Age and computer training tested statistically significant ($X^2=11,943$; $p<0,05$). The doctor in this study had received formal computer training followed by allied health professionals (69,6%), nurses (13,0%) and pharmacists (0,0%). The relationship between profession and computer training tested statistically significant ($X^2=13,216$; $p<0,05$). Health care workers in the rural areas were far less likely to have received formal computer training (17,4%) than their urban counterparts (73,9%). This relationship was statistically significant ($X^2=15,256$; $p<0,05$). Participants working in clinics were the largest group that had not received formal computer training (55,9%) followed by those working in the district hospital (17,6%), secondary hospital (14,7%), community health center (5,9%) and regional hospital (5,9%). This relationship was statistically significant ($X^2=15,530$; $p<0,05$). There was only a small difference between the participants who make use of Information Technology frequently (51,6%) and infrequently (48,5%) in regards to formal computer training ($X^2=18,546$; $p<0,05$).

Formal computer training received by participants was tested against behavioural intention to use Telemedicine within the next 12 months. It did not test statistically significant for the categories of planned, predicted or intended use of the technology. More participants ($n = 24$) who had not received computer training intended to make use of the technology than those who had ($n = 16$). An equal number of participants indicated that they planned to make use of the technology within the next 12 months ($n = 25$ for both). The same was found in the predicted

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use category with a number of 27 and 28 respectively for those who had received formal computer training and those who had not.

6.8 Conclusion

In this chapter the data collected by means of a questionnaire, was represented. The categories used for this representation followed the sub research questions in order to provide a logical and easy way to follow data analysis. The data was analysed making use of SPSS and categories were subdivided into the following: General response rate, socio-demographic characteristics of the participants, Telemedicine modalities, facilitating conditions, management support and computer literacy. The data was represented making use of tables, graphs and statistics as indicated by the chi-square test. Statistically significant statistics were indicated in the text. In the next section this data is then analysed and a discussion regarding the importance and significance of the findings follows.

Chapter 7

Analysis and Discussion



7.1 INTRODUCTION

Hofstee (2006) states that, once data has been collected, it still remains data. Therefore, to make sense out of the data, one needs to turn it into some sort of evidence – hence the process of analysis. As explained previously a questionnaire was used to collect data. The questionnaire was designed to answer the main and sub-research questions. The questionnaire was designed with various subcategories of the TAM and UTAUT theories in mind and provides an overview of the results of these theories. While the previous chapter presented the findings of the study, this chapter focuses on the interpretation of the findings pertaining to the various research questions. Each research question is addressed making use of the data obtained and relevant literature. From this analysis, Critical Success Factors (CSF) are identified that will improve the acceptance and use of telemedicine by health care workers. These CSFs are divided into different subcategories of technology acceptance making it possible to identify various factors that influence the health care worker. The CSFs are then validated against the literature on Information Systems and Telemedicine in order to improve the acceptance and use of telemedicine. The recommendations of the experts are incorporated into the final report in the appropriate section. The next section explains the response rate of the study.

Literature Study

- 7.1 Introduction
- 7.2 Response rate
- 7.3 Demographics
- 7.4 Telemedicine
- 7.5 Facilitating conditions influencing acceptance and use of technology
- 7.6 Management
- 7.7 Computer literacy
- 7.8 Critical success factors identified in literature
- 7.9 Validation
- 7.10 Conclusion

7.2 RESPONSE RATE

Traditionally one of the disadvantages of a survey type study is that the response rate or the number of participants returning the questionnaire is very low. This is demonstrated by Chismar and Wiley-

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Patton (2003) who reported a response rate of 43% in their study as well as Schaper and Pervan (2004) who only achieved a 25% return rate. Both these studies investigated information systems in health care similar to this study. If the response rate is very low it can cause the integrity of the data to be compromised and conclusions drawn from the data have the potential to be consistently erroneous. This will lead to an over- or underrepresentation of the corresponding parameter in the population. This study achieved a 76% response rate which is comparable with Kijisanayotin *et al* (2009) who reported an 82% response rate and Nwabuezo *et al* (2009) who achieved a 75% response rate with a survey method. The results of this study will therefore be generalisable to the general population of health care workers employed in the public health sector in developing countries making use of Telemedicine for clinical or educational purposes. The next section discusses the socio-demographic characteristics of the study participants.

7.3 DEMOGRAPHICS

The study population consisted mainly of females with males only a small proportion of the population. The nursing profession has traditionally been seen as a female dominated career. This is also true of the allied health professions such as physiotherapy, dietetics, speech and audiology as well as radiography. Tertiary learning institutions have been recruiting male students for these professions for some time, but there is still a vast discrepancy which must be addressed.

Almost half of the participants were older than 40 years of age. Technology is generally considered not to be well accepted by the older generation which can have a significant influence on the technology acceptance behaviour of Telemedicine. This was demonstrated by both Davis (1989) and Venkatesh (2000) who both included age in their theories as contributing factors for the acceptance of new technology. Younger adults are considered to be more computer literate as they have grown up with new technological developments and advances. In this study population a third of the participants were younger than 30 years old and were expected to be more open to the acceptance and adoption of new technology.

Educational level is considered important for computer literacy as higher educational qualifications are equated with increased exposure to computers in general. A computer

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literacy course is compulsory at most tertiary institutions for health care professionals and at hospital level there is ongoing training opportunities for nurses to increase their computer literacy levels. As health care is increasingly moving towards computerized systems in order to provide universal access to medical records and other results, it has become important that health care workers are able to use computers.

The percentage of participants in rural and urban settings was very similar with about half working in either setting. One of the main advantages of Telemedicine is that it connects health care professionals in the urban and rural areas with each other in order to provide support and guidance with clinical care and educational opportunities. The health care workers in urban areas are expected to be more computer literate but as the health care workers in the rural areas were trained at the same tertiary institutions, this does not always hold true. In this study the rural study population is represented by nurses who may have attended nursing colleges which are not as well equipped with computers as the more traditional tertiary universities. This may mean that the nurses stationed in the rural areas are not as familiar with computers as their urban counterparts. The ICT roll out in the rural areas is also not as advanced in the Eastern Cape as the urban areas. This is mainly because of funding and connectivity issues. The same holds true for the larger health care centers such as secondary and regional hospitals. The ITC budget in these centers is much bigger than in the community health centers and clinics as they are expected to provide support to the rural areas. In the next section the different modalities and self reported usage of Telemedicine are discussed.

7.4 TELEMEDICINE

A quarter of the study participants indicated that they never or very seldom make use of the system. This can be because of the nature of some of the professions where Telemedicine is not considered conducive to good clinical care. Rehabilitation such as offered by physiotherapy, speech and audiology needs a 'hands-on' approach or very specialized equipment which cannot be provided by Telemedicine. The specialized equipment may not be present in the rural areas or health care workers are not trained in using it correctly making it impossible to conduct hearing tests. While therapeutic techniques can be demonstrated for the patient and care giver on the one hand, the initial evaluation and re-evaluation of the treatment techniques must be done by a trained health professional in order to establish their efficiency. A large part of the study population consisted of allied health professionals including dietetics and

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radiologists. These two professions can certainly make use of Telemedicine in order to provide clinical services as the dietician only requires the patient to be weighed and measured for length and digital images can be sent via e-mail to referring hospitals.

More than two thirds of the study population considered themselves knowledgeable about Telemedicine in general. Twenty percent however did not consider themselves knowledgeable regarding the technology which is disconcerting as the Department of Health has identified Telemedicine as an integral part of future health care strategies and has invested considerable funds in the project already. A technology which has been internationally identified as a possible solution to improve health care in developing countries must be discussed at a tertiary level with health care workers in order to prepare them for its use when they are qualified. None of the universities at present offer more than a casual introduction to the technology. The older age group of health care professionals may also be part of this problem as they may not be as computer literate or as up to date with the newest developments in ICT.

The majority of the participants do not make use of the Telemedicine unit for a variety of reasons. As mentioned before some professions may prefer to make use of Telemedicine for diagnostic and not therapeutic reasons. Connectivity between the urban and rural centers may be a further obstacle as well as physical access to the unit as it has to be secured at all times. The unit must be accessed by all in a clinical situation whereas it would not be feasible to have a unit in each department of a larger hospital. This may mean that the unit is located in a certain department such as casualty or Intensive Care where it will be most useful for medical consultations but not accessible by all. Another possible explanation may be that the unit is not user friendly or health care workers simply do not make use of the technology. Computer literacy may also play a factor here as those that do not know how to use a computer would not be able to make use of the system itself. Telephonic conversations are the most frequently used methodology as this is the technology most available in a variety of settings, both urban and rural, and can be used for immediate feedback. E-mail usage depends on connectivity and the attending health care worker on the receiving side may not open or return a reply for a few days which may mean that patients must return to the clinic for follow-ups. The next section explores the different conditions mentioned by both the TAM and UTAUT models in order to explain user acceptance and use of technology.

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7.5 FACILITATING CONDITIONS INFLUENCING ACCEPTANCE AND USE OF TECHNOLOGY

This section explores the different conditions that will influence the acceptance and use of technology. These conditions are identified by the TAM and UTAUT and have been discussed in previous chapters. There are some universal problems that have been identified in literature as common to all developing countries when introducing new technologies into existing health care systems. These include donor financial support for a limited duration without enough focus on the development of local expertise for when the donor withdraws. Pilot projects are often introduced as new permanent technological systems which must still be tested or fine tuned before they can be rolled out to the larger health care environment. If this is not clear to the participants from the start they may become frustrated with the project and not wish to participate in it once it is rolled out permanently. The intervention or introduction of new technology is often too narrow as it does not take into consideration the existing health care political environment. New technology is not intended to reform the system. Technical bias of projects which includes inadequate focus on human resource development or technical assistance has also been identified as possible obstacles to introducing new technology into health care. One of the main recommendations to introducing new technology into health care successfully then includes that the global standard must be proactively implemented in order to accomplish local vision and objectives. The buy-in on ground floor must be present before any attempt is made to introduce Telemedicine to the health care workers otherwise it will not be accepted and used (Jacucci, Shaw and Braa, 2006).

7.5.1 PERCEIVED USEFULNESS

The definition of *perceived usefulness* is “the degree to which a person believes that a particular information technology will enhance their job performance” (Davis, 1989). More than 80% of the health care workers perceived Telemedicine as a useful technology in health care. Siracuse *et al* (2008) found that *perceived usefulness* and attitude of users had the most significant influence on intention to use and actual technology use. Some of the perceived advantages of Telemedicine useful in health care delivery according to the health care workers include the following:

- Quality improvement 79,0%

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- | | |
|----------------------------------|-------|
| • Increased control over work | 75,4% |
| • Improved efficiency | 73,6% |
| • Supportive of critical aspects | 71,9% |
| • Increased productivity | 77,2% |
| • Increased effectively | 80,7% |
| • Easier to do job | 79,0% |

Holden and Karsh (2009) found in an analysis of 20 studies making use of TAM to predict health care workers acceptance of new technology that *perceived ease of use* was not significant in any of the studies. The reasons why *perceived ease of use* and *social norms* were not able to predict intention to use new technology was explained by Holden through the increased computer literacy rate of health care workers in comparison to the general population, as identified in the study population. This is supported by Davis *et al* (1992) who also reported that ease of use becomes less significant as the user becomes more familiar with the system. Holden and Karsh (2009) then concluded that for technology to be accepted in health care, it must be perceived as useful to the health care worker and not necessarily easy to use.

The female participants found the technology consistently more useful than their male counterparts, possible because of the difference between the male and female representation in the study population. This is in contrast with Venkatesh *et al* (2003) who found men to be more influenced by *perceived usefulness* than *ease of use*.

A quarter of the health care workers younger than 30 years did not agree that Telemedicine would improve the quality of their work while those older than 50 years all agreed with this statement. Older health care workers are not as familiar with technology and still experience Telemedicine as a new development whereas the younger generation have grown up with new technologies and are aware of the potential and limitations. Similar results were found for the different qualification levels within the study population. The group with the highest qualification level was found to be least impressed with the potential benefits of Telemedicine while those with lower qualification levels were more readily impressed with the technology. The same argument as above can be applied to these results; those without previous exposure to new ICT would be more impressed with the technology as they are unaware of its limitations.

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This would explain why literature reports *perceived usefulness* and not *perceived ease of use* to be critical within this user group. Health care workers report that the factors they will consider when deciding to accept or make use of new technology include whether the technology is relevant to patient care as well as the quality and output of the system. Furthermore health care workers find technology useful if it increases their productivity, quality of care, effectiveness and overall service (Tule *et al*, 2005).

The health care workers in the smaller work settings (clinics, community health settings and district hospitals) reported that Telemedicine was useful in their job and provided them with more control in their work; those in a secondary hospital came last in this category. The table below provides a graphical representation of the results found among the different health care facilities for the question “Using Telemedicine gives me greater control over my work”.

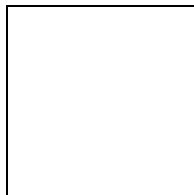


Figure 14: Using Telemedicine gives me greater control over my work

These results suggest that the smaller settings benefit the most from Telemedicine because their patients can be referred to specialists without the inconvenience of travelling. As the referring health care workers have to be present during the consultation, it also presents an educational opportunity for them to improve their clinical skills.

The perceived amount of knowledge of Telemedicine and the perceived ease of use were found to be significant. As the knowledge of Telemedicine increased among the health care workers, the perceived ease of use was also recognised. This is important as the acceptance and use of Telemedicine is influenced positively if health care workers are familiar with the technology. Half of the participants in this study indicated that they do not consider themselves knowledgeable about Telemedicine which suggests that they also do not recognise the potential of the technology in health care practice.

Holden and Karsh (2009) state that perceived ease of use is not likely to affect acceptance, but it does appear to correlate with usefulness. The reason for this may perhaps be that if a

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technology is difficult to use it cannot possibly be perceived as useful. The implication for the acceptance of new technology in health care then follows that design, training, and informational sessions must prioritise health IT before expecting improvement in health care outcome; technology must be easy to use. The next section discusses the second factor of the TAM - *perceived ease of use*.

7.5.2 PERCEIVED EASE OF USE

According to Davis (1989) the definition of *perceived ease of use* is “the degree to which a person believes that using the technology will be free of effort.” The health care workers who participated in this study agreed that Telemedicine would be easy to use with two thirds indicating that they found it easy to learn and find the system easy to use once in operation. Chismar and Wiley-Patton (2003) reported in their study that health care workers were not influenced by this condition as they were willing to adopt the technology if it benefited the patient even if it was difficult to use. The benefits are defined as improving productivity, quality of care, enhancing effectiveness and providing overall practical service.

Half of the participants however indicated that they found the Telemedicine unit cumbersome to use or required considerable mental effort to operate. A third indicated they found the system frustrating to use during their daily duties as they perceived it to be inflexible and rigid.

The females in the study population found the system easy to use, operate and user friendly. This could be due to the large percentage of females in the study population in relation to the males. Literature has however reported that women in general will accept technology if it is perceived to be easy to use (Venkatesh *et al*, 2003).

Qualification of the health care worker was found to determine the perceived ease of use; health care workers with degree qualifications found the system the least cumbersome to use or to operate. Interestingly this group was followed by those without a grade 12 qualification possibly because this group may have had special training as they were identified as a target group were limited ICT exposure prior to the introduction of the technology.

The health care workers in the rural areas found it more cumbersome to make use of the system or to learn how to use the system than their urban counterparts. This can be attributed to the limited ICT rollout in rural areas compared to urban areas as well as connectivity issues.

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Health care workers in the rural areas are more likely to have technical problems with the technology and the least likely to have technical assistance at hand when needed. This is supported by Hu *et al* (1999) and Holden and Karsh (2009) who found that health care workers in urban areas have more reliable access to assistance for e.g. for problem solving with technology.

The health care workers in the secondary hospital found it difficult in general to perform tasks with the Telemedicine system. This could be because adequate training was provided to the health care workers in the rural areas as they were considered less computer literate while their counterparts in the urban areas were not properly inducted into the system. The frequency of use may also play a part because urban health care workers are not as efficient when making use of the system. Repetition becomes very important when learning how to make use of a new system and health care workers in larger hospitals will only make use of the system if they are consulted while those in rural areas would use the system for each patient they refer. This is supported in the statistics with the health care workers making use of the system frequently indicating that they found it easier to interact with the system. Davis (1989) reported that ease of use becomes non significant with increased experience among users of new technology. Similarly Chismar and Wiley-Patton (2003) argued that the perceived ease of use condition will weaken as the competency of the user increases. In the next section the first of the factors associated with the UTAUT model are discussed namely Performance expectancy.

7.5.3 PERFORMANCE EXPECTANCY

Health care workers believe that Telemedicine will improve their productivity. The majority indicated that Telemedicine enables them to be more efficient and to increase their productivity. The type of facility where the health care workers are based also plays an important role when deciding whether the technology will be useful. The smaller type facilities all reported high percentages of increased usefulness of Telemedicine in their daily activities while the secondary hospital scored much lower. Similarly health care workers at smaller facilities indicated that Telemedicine would decrease their working time dramatically while those at secondary hospitals disagreed with the statement. The table below provides an overview of the percentages recorded for the different facilities for the question *Telemedicine will decrease my work time*.

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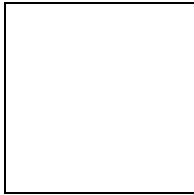


Figure 15: Telemedicine effectivity and place of work

This can be attributed to the secondary hospital being the institution providing the service which is seen as an extra duty for the health care workers while the smaller facilities receive more benefit from the technology. Health care workers at secondary hospitals must be informed that the main advantage of Telemedicine for them is the decreased amount of time spent on outreach activities taking them away from their main clinical duties. If more patients can be seen via Telemedicine it will also decrease the number of patients referred incorrectly or requiring attention at the secondary hospital.

7.5.4 EFFORT EXPECTANCY

The majority of the health care workers indicated that they expected the system to be easy to use. Those working in urban centres did not find the technology as easy to learn and make use of as their rural counterparts. This can be attributed to more intensive training given to the rural based health care workers because they were expected to be less computer literate than the urban based workers. The health care workers in urban areas also indicated that they used the technology less frequently making it more difficult to remember how to use the machine.

The health care workers that considered themselves knowledgeable about Telemedicine found it easier to make use of the system or become skilful at using it than those that did not consider themselves knowledgeable about the technology. This is important as health care workers in urban areas are not educated about Telemedicine; they are expected to be better informed about ITC in general. If they are not knowledgeable about Telemedicine it then stands to reason they will not learn or operate the system with ease decreasing the chances of acceptance and use of the technology. This is supported by Jack and Mars (2008) who suggest that obstacles such as cost, workload, education and effort expectancy can be more important when adopting a new technology such as Telemedicine than simply providing the resources or infrastructure needed.

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7.5.5 SOCIAL INFLUENCE

Social influence is important because it can influence the acceptance of the technology by introducing internal and external forces that will determine the success or failure of the final outcome. If social influence is contributed through external compliance it is associated with a negative influence on the users' attitude while internalization and identification will contribute towards a positive user attitude. Internalisation of the induced behaviour also plays a larger part than perceived usefulness in the acceptance and usage of new technology (Venkatesh, 2000). Outside forces such as political agendas of local community leaders have been identified in literature as an obstacle when introducing Telemedicine into a new area. Possible solutions suggested in the literature include establishing a rapport early on with different stakeholders in the local community and not associating the project with a particular political party (Baigiire and Godes, 2003). Further suggestions were made by Yarbrough and Smith (2007) to include external factors such as time, organisational issues, system-specific issues and personal factors when investigating social influence on the acceptance of new technology. They argue that these factors are unique to the health care setting and must be included in order to improve the accuracy of the prediction. These external forces were not investigated in the current study.

Internal social influence was important to the health care workers with at least two thirds indicating that outside people can influence their decision making regarding the acceptance of new technology. Females were more susceptible than males to outside influences. This is supported by Venkatesh (2000) who found that women were more susceptible to subjective norms especially in the early stages of technology adoption. Health care workers at the smaller facilities also were more prone to outside influences to accept new technology while those at secondary hospitals strongly disagreed with the statement. A possible explanation for this would be that health care workers at secondary hospitals do not need assistance as much as their rural counterparts and can simply consult with their colleagues if they do require assistance. The technology would not be necessary for this type of interaction and thus would not be important to the health care workers in larger urban facilities.

The health care workers who considered themselves knowledgeable about the technology were more prone to be influenced by social conditions such as management and peers. This may be because those that do know that Telemedicine is part of the national strategy to improve health care will expect to be told by provincial and local management to make use of the technology in

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order to reach the objectives. This will also be the user group that will realise the potential benefits of the technology for health care and will make use of the technology if it is available. Change management can be influenced in this way as proper communication and education regarding the technology can reduce resistance to the introduction of Telemedicine in the initial stages of implementation.

7.5.6 FACILITATING CONDITIONS

Literature has identified several facilitating conditions such as knowledge of the system, availability of and compatibility of existing infrastructure and technical assistance that will contribute to the adoption of new technology. Holden and Karsh (2009) found in his analysis of various studies investigating technology acceptance in health care that in all the studies facilitating conditions were significant.

In this study only half of the health care workers indicated that they did had the resources necessary to make use of Telemedicine. The majority of the health care workers indicated that they had the knowledge necessary to operate the system. The male participants in the study were more positive about the technology which is explained as men are considered more technological inclined than women. It stands to reason that in any activity there is a direct correlation between the skills required and the effort and time taken to perform the activity. An increase in skill would then lead to ease of use which in turn would reduce the effort expectancy and time needed to use Telemedicine.

Technical assistance was available to two thirds of the participants. The health care workers who did not consider themselves knowledgeable about Telemedicine were far less confident about the technical assistance available than those that were knowledgeable about Telemedicine. This could mean that the health care workers that do understand the technology are able to help themselves or are comfortable that they know when to ask for help when needed.

7.5.7 ATTITUDE TOWARDS THE SYSTEM

While the majority of health care workers indicated that they were positive about Telemedicine there was considerable apprehension and fearfulness when using the system. This can be directly attributed to the knowledge of and level of skill when making use of the system. The health care workers all agree that Telemedicine can improve service delivery. A few of the

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participants younger than 30 years disagreed with the statement. This can be attributed to a lack of knowledge or previous bad experiences with the system failing to deliver the expected outcomes due to technical difficulties.

The health care workers younger than 30 years have grown up with consistent new developments in technology which means that they will not be impressed when it is introduced into health care. The findings of the study suggested that this age group do not think that Telemedicine will make their work more interesting.

Feelings of apprehension when making use of Telemedicine was a common occurrence among all the health care workers. The user group most prone to apprehension were those with lower educational qualifications working in the rural areas. This can be explained as these categories of health care workers are expected to be exposed less to ICT and therefore less computer literate. The table below shows the difference in percentage between the rural and urban areas when asked if Telemedicine made them feel apprehensive.

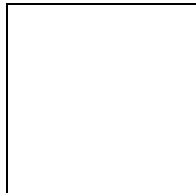


Figure 16: Apprehension and area of work

7.5.8 BEHAVIOURAL INTENT

Following on from the previous section, behavioural intent towards the technology was found to be very favourable. Most of the participants indicated favourably that they would be making use of the system in the next 12 months. This includes both the planned and predicted use of the technology during the next 12 months.

More females than male participants were planning and predicting to make use of Telemedicine. This can be explained by the large female to male ratio in the population. Venkatesh *et al* (2003) predicted that gender would no longer be a determinant of usage behaviour of technology in the future because both female and male users are exposed to technology from

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an earlier age; as the population ages technology discrepancies between the older and younger generations will decrease. The next section discusses the importance of management support for health care workers to be able to accept and use the technology in the study.

7.6 MANAGEMENT

When planning a new technology system for an organization, administrators should be able to predict whether the new system will be acceptable to users, investigate reasons why a planned system may not be fully acceptable, and then take corrective action to increase acceptability. This action will help to improve the business investment in time and money (Davis, 1989).

Dansky *et al* (1999) found that perceived organisational support is an important predictor of *perceived usefulness*. Behavioural intent was found to be influenced significantly by the support of higher authorities in this study. The support of the Provincial Department of Health was found to be very important to the health care workers in both the planned and predicted behavioural intent categories. More than half of the participants indicated that they planned to make use of the technology and perceived the Department of Health as supportive of the technology.

The planned and predicted use of the technology was found to be significantly linked to the local hospital management support structures, but health care workers perceived less support from local hospital management towards the technology than the provincial offices. The majority of the participants indicated that they had the necessary resources available to make use of Telemedicine. These resources would have to be authorised by the provincial or hospital management, thus indicating managerial support.

The knowledge level about Telemedicine was also found to influence the perception of management support. The health care workers that considered themselves knowledgeable about Telemedicine were found to consider management support much more favourably than those who did not. This can be explained as an increased knowledge of Telemedicine providing an improved insight into what is necessary to support the technology and thus a more accurate evaluation of the level of support provided by the provincial and local management.

Management support is very important to staff as this is the only way to communicate the objectives and goals of the technology once it is implemented. Otherwise there will be a mismatch between the project and individual user's goals which will lead to confusion and

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conflict. A possible solution to the above situation is to incorporate feedback loops between management and staff and include staff from the start when the introduction of the new technology is planned (Mitchell, 1995).

One of the other issues that must be addressed by management is the standardization of health care standards. This is very important as the universal standards imposed by WHO must be reinterpreted to local conditions and work practices in order to make them applicable to the local work environment. The aim is to reach a degree of coordination at national and provincial levels so as to improve efficiency of health management. This will include the building of local infrastructure and human resource capacity as well as the availability of adequate financial support (Jaccuci *et al*, 2006).

7.7 COMPUTER LITERACY

Computer literacy among health care workers is considered to be higher than the general population as health care continuously moves into the field of Information Systems in order to become more efficient and effective (Lemma, 2004). Due to the nature of medical qualifications, most tertiary institutions have made computer literacy part of the curriculum in order to prepare students for clinical practice. In this study the general computer literacy rate was self reported at 73,7% while none of the participants with a degree qualification considered themselves computer illiterate, supporting the point made above. Only 40% of the health care workers received some sort of formal computer training previously. The health care workers older than 40 years of age were more likely to have received formal training. Older individuals are often considered more resistant to technology and this group would have been identified for in-service intervention in order to increase their computer literacy (Venkatesh, 2000). In the nursing profession the older nurses often move from active nursing to a more sedentary work environment e.g. clinics due to physical reasons such as chronic back pain, to avoid prolonged times standing or lifting patients. In these types of settings computer work would be more appropriate than during active nursing in the wards where only the manager would have access to a computer.

Nurses were the group with the highest computer illiterate rate. This is important as nurses often are the main care providers in the clinics and community health centres in the rural areas. Even where there are doctors present in the rural areas the nurses would have to operate the

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Telemedicine system leaving the doctor free to conduct the physical examination. If the nurse is not computer literate she will not be able to make use of the system. This is supported by the computer illiteracy rates in the clinics, found to be the highest in this study; formal computer training rates were the lowest for health care workers based in rural areas especially in clinics.

More than half of the health care workers indicated that they made use of a computer for either personal or work purposes. This percentage decreases when qualification level is taken into consideration with those with a degree qualification being the main user group and those without a grade 12 qualification barely making use of a computer for either personal or work purposes. The rollout of ICT had been a priority in the Eastern Cape Health Department for the last few years in order to improve communication. Computers and training have been provided on a regular basis focusing specifically on the rural areas of the province. It is then disconcerting when on analysis the frequency of computer use by health care workers in the rural areas is much less for private or official use than their urban counterparts. These differences are also found in the computer training received by health care workers in the rural and urban areas. Only 17,4% of the health care workers in the rural areas had received formal training compared to 73,8% in the urban areas. The figure below graphically displays these findings.

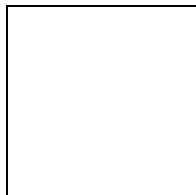


Figure 17: Frequency of pc use and area of work

When designing educational strategies to familiarise health care workers with Telemedicine, this becomes important as the intervention will have to take cognisance of previous IT exposure and skills. Those without a grade 12 qualification may need additional instruction in computer literacy before induction to Telemedicine is even attempted in order to facilitate the use of the system. This is supported by Lungo (2008) who proposes that when education is provided to familiarise the user with a specific computer programme it will be influenced by the computer literacy level of the user. The health care workers who were computer literate found it much easier to learn new programmes. The requirement that basic computer literacy skills must be

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included when undertaking information literacy education was put forth as a solution to the problem. Basic computer literacy skills will include mouse control, keyboard and Windows navigation requirements as well as Internet/e-mail capabilities.

The majority of health care workers have made use of either e-mail or a digital camera for either personal or work use which is important as the most rudimentary Telemedicine system makes use of these two modalities to communicate with distant health care professionals. Although any medical case can be documented via photographs, the discipline of Dermatology in particular has found this very useful when examining patients via Telemedicine.

The health care workers in the rural areas did not make use of computers for work purposes. This affects the computer literacy rates in these areas as well as the ITC infrastructure. If the infrastructure is not in place it will become very difficult to roll out Telemedicine to these areas where it will benefit the health care system the most. The next section discusses the critical success factors that must be taken into consideration when implementing new technology in order to maximise user acceptance.

7.8 CRITICAL SUCCESS FACTORS IDENTIFIED IN LITERATURE

Critical Success Factors (CSFs) are defined as those aspects of a strategy that must be achieved to successfully meet the objectives of the project (Collins English Dictionary, 2003). CSFs are used to identify a few key factors that a project must focus on to be successful. There are a variety of reasons why technology and specifically Information Systems introduced into the health care setting, does not succeed. Previous research has been conducted to identify these reasons in order to develop strategies to improve user acceptance and use of these Information Systems.

In the South African context the following were identified by Littlejohn, Wyatt and Garvican (2003) as possible factors that contribute to the failure of the acceptance of Information Systems in health care:

- Not taking into account health care cultures;
- Underestimating the complexity of health care processes;
- Different expectations from various end users;

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- Long implementation time with fast managerial change;
- Reluctance to provide more financial resources if the project is failing and
- Failure to look for and learn from failures of past projects.

Taking the above mentioned reasons as well as the factors identified in the previous sections into account the following CSFs were identified to address these issues. The following sections provide an overview of the various categories that can contribute to the successful adoption of Telemedicine among health care workers in the Eastern Cape followed by a more detailed list of the CSFs.

7.8.1 MANAGEMENT SUPPORT

More than half of the health care workers indicated that they perceived the Provincial Department of Health to be supportive of Telemedicine while less than half of the health care workers indicted that they perceived local hospital management to be supportive of the technology. The roles of these two authorities in ICT differ and must be addressed separately when introducing new technology systems.

The role of the provincial Department of Health is to address the lack of e-health policy to ensure a coordinated and well regulated environment. Areas in ICT in the health sector that must be addressed thorough legislative frameworks include ethical issues such as privacy and confidentiality of patient data. According to Mokgabudi (2008) the following must be considered when addressing policy issues in the health care sector:

- To strengthen the development of a comprehensive and integrated health information system;
- To facilitate the development of health information standards;
- To implement security measures to safeguard the privacy of patient information inherent in electronic health records;
- To ensure that all health care facilities have access to adequate ICT infrastructure;
- To facilitate the development and implementation of a national telemedicine programme;

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- To develop and implement an integrated (national, provincial and local government) health promotion strategy using ICT;
- To facilitate the development of an ICT human resource strategy;
- To develop an ethical framework for the effective use of e-health by health professionals and
- To promote an e- health research and development programme.

Once the policy is in place, evaluation and monitoring must be done in order to provide meaningful, comparable information on health system performance. It is then important to develop an adequate operational document which includes evaluation and monitoring. The data obtained in this way can be used to explain performance variation and solve the problems that arise. It can also be used in future projects in order to avoid similar pitfalls. Making use of this information will strengthen the scientific foundations of health policy at both the international and national level enabling governments to provide resources based on scientific reasoning (WHO, 2004).

The local hospital management often do not fully appreciate the impact of ICT or the disadvantages of lagging behind in this field in medical education or clinical care which means that the issue is not addressed with urgency. Even when such awareness is present the response usually is limited to attempts to introduce computer literacy among staff and seeking the use and acceptance of technology by health care workers rather than to fulfill a more comprehensive vision. These shortfalls however did not deter the health care workers in this study to make use of Telemedicine as they indicated that they did plan to make use of Telemedicine during the next 12 months.

The priorities of both the provincial and local management level must be communicated to the local level with adequate education. This will ensure that the priorities at both levels compliment each other. Appropriateness of these policies can be measured in terms of power requirements, security, environmental conditions, and other aspects of the local situation. The technical specifications and usability of the ICT targeted in the project or policy must also be suitable to how people and organizations need and want to put technology to use.

A problem discussed in literature that pertains to this area is the turnover rate of managerial staff in health care. Littlejohn *et al* (2003) found that while Telemedicine was implemented over

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a set period of time, the turn over rate of the managers involved with the project, was high. This meant that new staff had to be constantly inducted into the project which wasted time and money. Alternatively the new manager may not see Telemedicine as a priority area and withdraw funds or resources from the project making deadlines extremely difficult to adhere to.

Communication between management and end users must also be prioritized. Furthermore education about Telemedicine for all health care workers must be initiated early in the project in order to improve their knowledge about the technology. Management should also make it clear that Telemedicine is not an optional referral system. Once the resources are available, it should be compulsory for health care workers to make use of the system in order to speed up consultations with specialists or create educational opportunities. The provision of local and relevant content for educational purposes is important as users will only make use of Telemedicine for this purpose if they find it useful.

7.8.2 ADEQUATE EDUCATION

While the computer literacy rate among the study population was relatively high (73,7%), the percentage of health care workers who received formal computer training was only 40%. It has been reported in the literature that the level of confidence in technology is a defining issue in the acceptance of ICT in both developing and developed countries. This confidence can only be gained from education – either computer literacy or information literacy. Here information literacy refers to the knowledge of the system and operational requirements while computer literacy refers to the basic functions associated with the use of a computer. For developing countries these issues extend to privacy, data protection, security and cybercrime. If the end user is not confident about how safe the technology is it will limit the way health care workers are willing to use the technology. This lack of awareness becomes even more important as these risks can cause health care workers not to accept or use the technology at all. As part of the effort to educate end users about new technology, the risks involved in ICT and ways to guard against it must be included. In this study only 40,4% of the health care workers had received any kind of formal computer training.

ICT is a tool to be used to improve health care service and should not be considered as a means in itself. The educational aspect must be started early in the implementation phase and concentrated on the 'why' rather than 'how' the system works. If buy in from the end users of

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the system is obtained early on it will improve the chances of success dramatically. Activities can include conducting awareness campaigns, induction activities as well as basic and advanced training. Education must also include computer literacy skills as the health care workers in the rural areas may not have been exposed to ICT before. If computer literacy levels are increased the effort of learning how to use Telemedicine will be decreased which will increase user acceptance among the health care workers. The groups identified in this study as possible target groups include nurses (only 13% of this group had received formal computer training) and health care workers in the rural areas (17,7% vs 73.9% in urban areas).

Education should be provided making use of scientific concepts such as evidence based practice and existing literature to increase the credibility of the technology. In order to facilitate the above training facilities, universities must include Telemedicine as part of their curriculum to familiarize the students with the concept. Speciality areas around Telemedicine must also be offered by tertiary institutions in order to promote interest and advance knowledge in this subject area.

7.8.3 CHANGE MANAGEMENT

Change management is defined as a structured approach to transitioning individuals, teams or organizations from a current state to a desired future state (Collins English Dictionary, 2003). The process is aimed at empowering health care workers to accept and embrace changes in their current environment. When new technology is introduced into the health care setting it will bring about changes in work patterns and responsibilities. These changes must be anticipated as they relate to workload at the main and peripheral sites. The goal however should be to integrate Telemedicine into the established work practice with consideration that the skill requirement of the staff may have to change.

One of the barriers that should be addressed is that although Telemedicine may increase the workload initially as the technology will have to be implemented into existing practices and routines, but once this is done it will increase productivity. In this context, integrating technology use into peoples' daily routines is a major hurdle for many ICT development initiatives. Yet this seemingly obvious issue is often overlooked by ICT projects and policies, where technology use becomes an additional burden to the already over-burdened lives of people in developing

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countries, and this proves to be a factor that limits widespread technology uptake. People are unlikely to use technology if it involves efforts that outweigh the benefits.

This must be taken into account when designing Telemedicine systems as they must contribute to the daily routine already in place rather than impose an additional workload on the health care workers. To solve these, end users must be involved from the start of the project in order to provide valuable input that can be used when designing and developing the system. Feedback should be provided to the end users on a regular basis in order to check that the expectations of this user group are being met. Including all stakeholders in order to promote cooperation is very important for both the referring and referral institutions. In this study it was found that the health care workers in the secondary hospital were not as enthusiastic about the advantages that Telemedicine could provide to increase clinical services. This is illustrated through the following:

- Only 36.0% of health care workers in secondary hospitals indicated that they thought Telemedicine would decrease their working time;
- Only 30,8% of health care workers in secondary hospitals indicated that they found the system to be clear and understandable to use;
- Thirty eight percent of health care workers in secondary hospitals found it difficult to learn how to use the system and
- Half of the health care workers in secondary hospitals found Telemedicine useful in their jobs.

When the technology is first introduced it is important to set goals that are achievable in order to prove to end users that Telemedicine is advantageous to the daily health care routine. To do this Telemedicine must address the majority of the problems experienced in rural areas and especially at primary care level. Here a good starting point will be to target problems that can be solved easily by obtaining a second opinion such as conditions in radiology, dermatology, pathology and ophthalmology (Kifle *et al*, 2008). As mentioned above the health care workers at the secondary hospitals consistently returned negative scores for performance and effort expectancy and it stands to reason that this group will not be able to accept and use Telemedicine. As it is very important that buy in from the specialists at these hospitals is

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obtained in order to provide a functioning Telemedicine referral system, the change management strategies of communication, education and goal setting become very important for the implementers of Telemedicine.

7.8.4 INTRODUCE A CHAMPION

Projects to introduce new technology must start at the local level with context-specific approaches and working with all the necessary stakeholders in order to build the Telemedicine system according to the findings of the needs assessment. This process involves a collection of activities such as education, awareness-raising and engagement with the end users who will be using the Telemedicine system. This kind of broad process will lay a foundation for local buy-in and a sense of ownership among beneficiaries, and it will necessarily lead to a context-specific project.

Social influence was found to be very important to the females (67,3%) and health care workers in the smaller health facilities (65,3% in clinics and 100,0% in community health centres). One of the ways to facilitate social influence is to introduce a champion who will advance the objectives of the project.

Various studies have revealed that the appointment of a champion to promote Telemedicine will increase the acceptance rate of the health care workers. A local champion is someone who understands and embraces the objectives, supports technology-based solutions and is trusted by the community of health care workers. This study found that the health care workers in secondary hospitals are not susceptible to social influence (only 69.3% indicated that they would be influenced), but making use of a champion may address this problem. By working with a local ICT champion who embraces the potential benefits of technology, the initiative can engage an ally to support and promote ICT use among local stakeholders. The champion should play a key role in communication with the different stakeholders, be an advisor to the initiative, and act as a catalyst to help the initiative introduce innovation. This individual may not necessarily be on site in the health care setting, but must have a concrete connection that can be leveraged.

The Department of Health must ensure that all stakeholders are consulted to ensure local ownership of the project. Literature has found that the bottom-up approach is far more successful when implementing Telemedicine projects than the top down approach as it means

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the project is grounded in the realities of the community situation. Eventually all sponsors, donors and external trainers will have to hand over the project to the local facility in which it is implemented. If the health care workers at this facility have not embraced the technology before this happens, there is the possibility that it will become a 'white elephant'. A good way to ensure this ownership and proper communication is to identify a champion early on in the process. The disadvantages with this approach however include that the champion may promote Telemedicine to the health care workers but they may 'gold plate' the technology. This would mean the champion promises that the technology will deliver advantages which it cannot possibly meet. Another disadvantage is if the champion leaves the institution or becomes disillusioned with the technology for some reason, there is often a void that cannot be filled easily and will decrease the chance of successful implementation.

7.8.5 FINANCIAL MANAGEMENT

Half of the health care workers in this study indicated that they had the resources necessary to make use of Telemedicine. These resources include infrastructure and technical assistance when needed. While provinces have different health challenges it means that the financial priorities will differ from province to province. Traditionally ICT has been perceived as expensive and with no concrete evidence to show differently, a minimal budget has been allocated for Telemedicine in health care. Recent technological advances however have meant that Telemedicine is now more affordable and efficient than before and can be implemented making use of existing infrastructure (Mokgabudi, 2008).

When funding is allocated it is important to be able to account for the expenditure of these resources. When the underlying fundamental factors of the project are not correct a project is more likely to fail even if additional financial resources are made available to correct these mistakes. It becomes very difficult to then determine when to stop funding or to continue in the hope of achieving some result. While affordability is an immediate problem, it shifts to a question of sustainability in the long-term. Policy-makers and development practitioners need to make realistic choices about introducing costly ICT services in poor communities, and may be better off integrating creative uses of inexpensive technologies into development efforts. The long term sustainability of the project and maintenance of the equipment must also be considered as Telemedicine will require ongoing financial assistance from the Department of Health (Kifle *et al*, 2008).

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7.8.6 TECHNICAL ASPECTS

The physical access to technology goes beyond the availability of hardware, software and telecommunications networks. In developing countries, it is also important to consider geographic, environmental and contextual challenges that can affect physical access to ICT. This can include basic infrastructure requirements such as electricity or people with disabilities who will face particular barriers to technology access.

Successful projects used a thorough technology assessment to select the most simple and least expensive equipment to meet the clinical requirements. They also took into account (Mitchell, 1995):

- The rapidly changing nature of the technology ;
- Open architecture to create flexible systems ;
- The potential for leasing rather than buying equipment and
- Human-factors issues

It is important to provide the resources necessary for Telemedicine to be successful. Important here is that 40,3% of the health care workers in the study indicated that Telemedicine was not compatible with the existing infrastructure and only 64,9% had access to technical assistance if they required it. This can include the physical infrastructure, technicians and assistance when problems occur. Local conditions and limitations such as electricity supply must be taken into consideration when choosing the physical infrastructure of the Telemedicine system. The technology must be operational as much as possible with additional provision for down time such as the 'store and forward approach'.

The functionalities of the system must work properly so as to provide the end users with immediate benefit. These functionalities must be user friendly and be compatible with existing infrastructure so as to avoid further expenses to upgrade the existing infrastructure. If the system does malfunction, technical assistance must be on hand in order to avoid end users being inconvenienced. Software problems such as password access must be dealt with in a universal and transparent way in order to avoid some health care workers feeling antagonistic towards the users who do have access. Simpler issues such the mobility of the unit must also be addressed. If the unit is too heavy or cumbersome to move from room to room the health

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care workers will be less prone to using it. In that case a permanent location should be made available with adequate resources for the unit to be used in one single location.

Content must also be considered as it is important that the applications serve the needs of the underserved areas. If potential users do not find ICT useful, it will not be accepted. Even if the technology is imported from overseas the content must still be adapted in order for it to be considered local. End user participation will be important during this process as their valuable input regarding health care services will guide the developers. A bottom-up approach is far more likely to succeed during such a consultative process than a top-down approach as it provides the realities of the health care situation on the ground in order to realise the needs, interests and participation of the local residents.

7.8.7 PROJECT MANAGEMENT PRINCIPLES

When introducing a new technology it is important not to overwhelm the users with all the technical aspects associated with ICT. Rather plan the introduction in stages with concrete milestones which will ease user anxiety and provide the users with an opportunity to master fundamental skills before continuing with more complex concepts.

According to Mitchell (1995) these principles include early involvement of all stakeholders, conducting a needs analysis, clearly defining aims and objectives, developing a project plan with clear roles and responsibilities, regular feedback sessions, developing a clear operational management system, monitoring methods to measure the achievement of objectives, setting of smaller milestones and making use of proper project management tools such as Gantt charts in order to track progress easily.

A needs analysis of the local situation will provide valuable insight into what the health care workers need to improve health care in their specific area. This will include factors about the specific local conditions, human resource capacity and infrastructure, the needs and desires of the end users and other factors such as training or computer literacy that will affect technology uptake and sustainability in this setting. Doing a need analysis means not only looking at the present situation, but also previous projects of a similar nature in order to learn what has worked and what has not worked. Even if the technology has never been introduced in South Africa before, it is worth researching similar projects in other African or even developing countries

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around the world. Lessons learned from previous projects will enable the project manager to avoid the same pitfalls and build on what was previously learned.

With the introduction of any technology it is important to ensure that the project plan is flexible. New technology standards are constantly being developed, and new products introduced to the market. To stand the test of time, development initiatives should avoid getting locked into a specific technology, and use technologies based on open standards whenever possible. Once a project is underway, a technology-neutral approach leaves room for the project to change and adapt technologies as needed. Technology use built on open standards makes it easier for initiatives to shift between technology solutions.

Solutions can be developed for the local environment and specific needs of the health care workers which means that the technology will be sustainable in future. This means that unless the technology is perceived as being easy to use, reliable and effective, the system will not be used by health care workers on a regular basis. It is important to set concrete goals and take small achievable steps within a realistic timeline. If the project fails to meet the expectations of what is required, these clear targets will provide a focus point to get things back on track. Setting unrealistic goals can also lead to problems when initiatives do not deliver what they said they would, leaving communities feeling discouraged and distrustful. And while funders usually require well-considered objectives and deliverables, they often put pressure on projects to deliver results that fit within timeframes set to their funding cycles, which may not always line up with what makes sense for the project.

Evaluation must not just be conducted on the technology itself but must include an overall view of the impact of Telemedicine on health care. Very often evaluation techniques are not specified at the start of the project making it impossible to monitor variables to compare pre- and post implementation. This then becomes a problem when no data is available to do proper evaluation of the effectiveness of the system. This valuable information can be used to justify or motivate for more resources as well as the roll out of the system to other rural areas.

From the information discussed above the following table was compiled in order to summarise the CSFs that were identified during the literature study as well as the analysis of the data of this study. The table below provide an overview of the specific CSFs and the different conditions as identified by the TAM and UTAUT that each addresses.

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Table 12: Critical success factors

CRITICAL SUCCESS FACTOR		TAM and UTAUT conditions
CSF 01	Implement and disseminate best practice within a legislative framework	Perceived Ease of Use
		Perceived usefulness
		Social influence
		Facilitating conditions
		Performance expectancy
CSF 02	Find a champion	Performance expectancy
		Social influence
		Facilitating Condition
		Attitude towards the system
CSF 03	Change management strategies	Perceived Ease of Use
		Perceived usefulness
		Social influence
		Attitude towards the system
		Effort expectancy
		Facilitating Condition
CSF 04	Training Education of health care workers including PC literacy and information	Perceived Ease of Use
		Perceived usefulness
		Performance expectancy
		Effort expectancy

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	literacy • Training at universities to provide speciality areas and research opportunities	Social influence
		Facilitating conditions
		Attitude towards the system
CSF 05	Sustainable finance	Attitude towards the system
		Facilitating Condition
CSF 06	Technical issues • Infrastructure • Technical assistance	Perceived Ease of Use
		Perceived usefulness
		Social influence
		Attitude towards the system
		Effort expectancy
		Facilitating Condition
CSF 07	Project management principles • Needs analysis • Communication • All stakeholders included • Ensure ownership • Defining aims and	Perceived Ease of Use
		Perceived usefulness
		Social influence
		Attitude towards the system
		Effort expectancy
		Performance expectancy
		Attitude towards the system
		Facilitating conditions

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	objectives • Regular feedback • Set concrete goals • Achievable milestones • Clear roles and responsibilities • Monitoring and evaluation	
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7.9 VALIDATION

Positivist research concludes that the validity, objectivity, reliability, internal validity and external validity of the study must be addressed in order for the research findings to be credible (Oates, 2006). According to De Vos, Strydom, Fouche and Delport (2005) dependability and trustworthiness are important in any study. Validation was provided in this study by making use of well known researchers, authors and institutions while constructing the theoretical framework and CSFs. The questionnaire for this study was compiled making use of the well known TAM and UTAUT models. This is in alignment with Saunders, Lewis and Thornhill (2003) who emphasise that a credible question will ensure the collection of accurate data and for data to be collected consistently. The questionnaire then becomes a credible standard by virtue of the trustworthiness of the source documentation.

The CSFs were also validated by four external experts in Telemedicine. The definition of validation include "...to confirm or corroborate..." and "...to give legal force or official confirmation to..." according to the Collins English Dictionary (2003). Making use of relevant literature and the results found in this study, critical success factors were identified that must be taken into consideration when Telemedicine is introduced to health care workers in the public sector. These critical success factors were evaluated by experts in IT and Health Informatics in order to validate the results. These groups were identified as the most appropriate to validate

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the findings as they provided expertise and skills in both the technical and information system spheres of Telemedicine. Even though this study did not investigate the technical challenges associated with Telemedicine it was identified as a critical success factor in the primary and secondary data. It then becomes important that the experts validating the CSFs do have some skill in this area. The Information System experts were chosen to evaluate the CSFs to do with the system itself. Two experts from both fields were contacted and asked to review the findings. This is important as the critical success factors identified must be incorporated into future roll out plans for Telemedicine. The input of the experts was used to make sure that the CSFs encompass a broad strategy which has taken into account all possible factors that can contribute to the acceptance and use of Telemedicine. The feedback received from the four experts was very positive. All indicated that they believed the CSFs that were identified would be beneficial to the acceptance and use of Telemedicine. The comments received included that the CSFs cover a broad range of topics which will help to successfully roll out Telemedicine to both the rural and urban areas. The experts expressed the view that the urban areas must also be taken into consideration as they present different challenges from the rural areas. The way the technology is 'pitched' to urban health care workers is very different as the benefits will be different for these professionals. Another CSF that received much praise was the inclusion of the educational aspect of Telemedicine. It was felt that this specific aspect is often overlooked and neglected. The project management principles were thought to be very important as the skill learned from the Telemedicine project will be carried over to other projects increasing the skills of health care workers outside the Telemedicine project. In general the range of CSFs was found to be adequate as it will address the issues raised in the literature study and primary data analyzed during the study. The experts indicated that the CSFs were thought to be of benefit to the research body relating to Telemedicine as they would provide guidance to those who must implement Telemedicine in the developing countries.

7.10 CONCLUSION

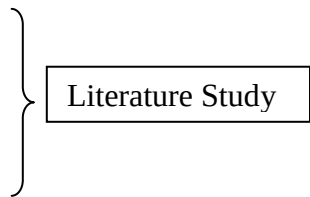
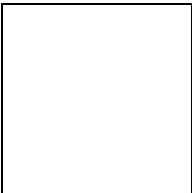
This chapter provided the analysis and discussion of the data gathered and reported during the previous chapter. Making use of existing literature, it compared the findings of the study with previously reported studies in order to draw conclusions about the similarity or differences between them. The chapter started with a thorough discussion of each of the research questions. From these conclusions CSFs were identified in the next section. Once again existing literature and primary data were used to substantiate why these CSFs were important in

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the current study situation. Making use of the results of the current study as well as previous literature reported also provides the added advantage that these CSFs can be generalized to other similar settings. This means that the results can be generalized and provide an important contribution to the body of research about Telemedicine in the public health care service in developing countries. The next chapter is the conclusion of the study and provides an overview of the various chapters.

Chapter 8

Conclusion



8.1 Introduction

The previous chapter discussed the findings of the study and provided the CSEs necessary for Telemedicine to succeed in the public health care system in developed countries. The findings identified in this study were supported by the primary data of the study and the secondary data from the literature review. This chapter starts with a review of the relevant literature as important to the findings of the study, then discusses the methodology, the results of the data collection as well as the discussion of these results. The CSFs are once again identified and discussed in relation to the research questions. Finally the limitations of the present study and the future research are given in order to provide future researchers with a warning of the pitfalls of this study as well as provide valuable insight into what can be learned from this field of Telemedicine. The next section provides a brief discussion of the literature review.

- 8.1 Introduction
- 8.2 Literature
- 8.3 Research question
- 8.4 Theoretical framework
- 8.5 Research methodology
- 8.6 Discussion
- 8.7 Future research
- 8.8 Limitations
- 8.9 Summary

8.2 Literature

It is well documented in the literature that the quality of health care in the urban and rural settings of South Africa is not equal. These inequalities exist because of a variety of reasons such as a shortage of personnel in the rural areas; urbanisation of specialist services; long distances that a patient must travel in order to reach medical assistance and the isolation of health care workers in rural areas from educational opportunities and peer assistance.

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ICT has been identified as one possible solution to address these inequalities. Some of the typical advantages that ICT can provide include patient care such as safety, quality and efficiency as well as providing evidence and data to support clinical practice, research and policy. Telemedicine in particular has been singled out as the technology that will be able to achieve these benefits and is recommended by the WHO to developing countries as a strategy to improve health care. The problems associated with the initial implementation of the technology include the cost and technology limitations, but new technological advances have meant that the cost of technology has decreased while connectivity issues have been addressed in developing countries. Telemedicine in its most basic form makes use of telephones or e-mail contacts between remotely located health professionals. More recently high end technology and sophisticated network communication such as video conferencing are also being used where available. Services that have been enhanced by Telemedicine include dermatology, oncology, primary health care, emergency care, physical rehabilitation (mentoring and supervision), surgery, pediatrics, psychology/psychiatry, radiology, pathology, ophthalmology and obstetrics (Whitten and Love, 2005; Cellar, Lovell and Basilakis, 2003; Dhillon and Forducey, 2006).

Some of the other proven benefits of Telemedicine include the increased quality of care, saving time and cost for the patient and decreasing the isolation of health care workers through providing educational and training opportunities in rural areas. There is however problems associated with the acceptance of the technology as well. These include technology infrastructure with issues such as the reliability, quality, calibration and patient safety of the equipment used. The slow uptake of Telemedicine among clinicians is attributed to the limited amount of outcome based research available to support the claims of increased efficiency and effectiveness. The implantation of the technology was also found to be influenced by the organisation fit and in particular the time and cost health care workers have to invest in order to learn how to make use of the technology. Finance has been identified as an additional problem to accept the technology. Only a limited number of studies were found to consider cost effectiveness among the advantages that Telemedicine will provide. This means that there is very little empirical evidence available to support the claims of cost effectiveness of the technology. Legislative issues such as policies and laws are also not in place as it pertains to Telemedicine and while it is being developed health care workers are exposed to legal issues such as confidentiality and security threats. The challenge then is to provide Telemedicine

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solutions that are self sustaining, simple, transparent and flexible enough to meet the unique needs of the health care system.

The developing world has embraced Telemedicine with many examples in countries around the world and especially in Africa. These include African countries such as Ghana, Kenya, Uganda and Mozambique partnering with European countries such as Sweden or Britain. Telemedicine is being used for both clinical and educational purposes in these countries. The projects are often sponsored jointly by the local governments in the respective countries that make financial resources, technology and human resources available to assist developing countries.

South Africa is considered a leader among the developing countries in the development and rollout of Telemedicine. Despite the backing of the National Department of Health, Medical Research Council and private sponsors such as MTN, the uptake of Telemedicine has been limited at best. Currently only 37% of projects are considered to be successfully implemented despite the financial and political resources available to roll out the Technology.

In the Eastern Cape Telemedicine was first introduced at Walter Sisulu University in 1995 with a telepahtology link between the Eastern Cape and United States of America, Germany and Croatia. The Eastern Cape Telemedicine Unit was formally established in 1999 to co-ordinate research and the implementation of Telemedicine projects around the former Transkei. Since then 27 clinics, 5 district and 1 regional hospital have been introduced to Telemedicine. The services provided include teleDermatology, teleECG, teleSpirometry, teleRadiology and teleTrauma. The provincial E-health education centre is providing assistance to health care workers to further their education in 3 academic programmes. The next section states the research questions and objectives as identified in Chapter 1.

8.3 RESEARCH QUESTIONS

The research question that this study investigates is: *What critical success factors will influence the acceptance and continued use of Telemedicine in the Eastern Cape Department of Health?*

To answer the above research question three sub research questions were identified:

1. *What facilitating conditions are necessary for the adoption and continued use of Telemedicine in the Eastern Cape?*

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2. *What effect does management support have on the decision to make use of Telemedicine?*
3. *What role does previous exposure to Information Technology have on the user that will help predict the likelihood of Telemedicine being adopted and used?*

Once these research questions were answered CSFs were produced in order to provide guidelines to future Telemedicine projects in developing countries about what topics must be considered and addressed in order to increase the success rate of the technology from initial adoption to full adoption. The following section provides a summary of the theoretical frameworks, TAM and UTAUT that were used to produce the CSFs in the study.

8.4 THEORETICAL FRAMEWORKS

In order to identify the above mentioned CSFs, two theoretical frameworks were used namely the TAM and UTAUT models. This became important as the literature previously published making use of these two models in health care could be used to support the findings of this study. Very little research was found regarding technology acceptance of Telemedicine in South Africa or Africa and even where it was available, it focused almost exclusively on pilot projects. These projects are often externally funded and have a sponsor who will drive the process to rollout Telemedicine. Literature then reported that once this sponsor withdraws from the process, the technology becomes redundant or fails to meet the initial expectations.

The TAM was developed by Davis in 1989 and has since become the cornerstone of technology acceptance research. It has been validated in many different settings with different categories of users in both mandatory and voluntary situations. It is used to depict the *perceived usefulness* and *perceived ease of use* that will ultimately determine the user's intention to make use of new technology and can therefore be used to predict and validate the factors that will influence technology adoption, acceptance and use.

In contrast the UTAUT model was developed through the consolidation of 8 different models including the TAM. It can be used to explain user intentions to use Information Systems and the subsequent usage behaviour. The four key constructs that directly influence the usage intention and behaviour are *performance expectancy*, *effort expectancy*, *social influence* and *facilitating*

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conditions. Aspects such as gender, age, experience and voluntariness directly impact the key constructs on usage intention and behaviour. Like the TAM the theory has been validated extensively in literature among a variety of situations. The UTAUT was found to be able to explain 70% of technology acceptance behaviour in health care workers, a significant improvement on previous models which routinely explain only 40% of acceptance. The next section provides a brief overview of the research methodology that was used to conduct the study.

8.5 RESEARCH METHODOLOGY

The study made use of a positivistic paradigm. The research strategy adopted for this study was a quantitative approach making use of a survey research design. A questionnaire was used as it was found to be cost and time effective to survey the health care workers in the Eastern Cape Province. The questionnaire was developed making use of the original questionnaires developed for the TAM and UTUAT models. Sections on computer literacy and managerial support were added as found appropriate in order to adequately provide data to answer all the research questions posed. A pilot study was conducted before the main research study and it was found that although the questionnaire was user friendly, a section should be included on the different modalities that can be used to make use of Telemedicine.

The study population consisted of health care workers at various Telemedicine sites around the Eastern Cape. Seventy five health care workers from the multidisciplinary team participated in the study. The questionnaire was sent to the health care workers via e-mail and delivered to areas not connected to the Internet via the local supervisor. Exclusion criteria for this study include technology issues associated with Telemedicine as well as budget and other financial constraints faced by the implementers of the technology. Telemedicine used in the private sector was also not included in the study. Inclusion criteria include Telemedicine used for clinical practices as well as training in the public health sector.

Data analysis was done making use of SPSS. Illustrative, descriptive and analytical statistics were obtained. Validity and reliability of the data was ensured making use of a pilot study and data cleaning methods.

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The validation of the CSFs was done by a panel of four experts in Telemedicine and technology acceptance. Feedback from the experts was incorporated into the final recommendations and conclusions of this research project.

The following ethical considerations were considered during the research project. The questionnaire was completed anonymously by the study participants ensuring privacy and confidentiality. Participants in this study were assured that the information obtained would not be made available to anyone who was not directly involved in the study and formal consent was obtained from the East London Hospital Complex and University of Fort Hare before the study was conducted. Study participants also received a covering letter explaining the purpose of the study and informing them that participation in the study was voluntary.

8.6 DISCUSSION

The analysis of the data obtained from the questionnaire revealed that there were specific groups that did not perceive Telemedicine to be a useful technology. These groups include the health care workers younger than 30 years old with a degree education and working at a secondary hospital. Similarly these groups indicated a negative perception in regard to the performance and effort expectancy associated with Telemedicine. It then becomes important to target these groups and provide adequate education regarding the importance and benefits of Telemedicine. Overall there were some of the health care workers that perceived the technology to be rigid, inflexible and needed technical assistance to operate it. Ease of use although identified in the literature as not as important as usefulness to health care workers, must be addressed as it will decrease the user acceptance of the technology. Social influence was found to be more dominant among the female health care workers in the study. Those in the clinics were more prone to social influence when accepting new technology while the health care workers in the secondary hospital were not influenced by this factor. While some of the health care workers did not believe they had the resources necessary to make use of Telemedicine such as technical assistance and infrastructure, it was found that if the health care worker was more knowledgeable about Telemedicine the perceived effort and skill associated with the technology would decrease. Similarly it was found that the less educated health care

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workers in the rural areas feel more apprehension when making use of the system. The overall behavioural intent was found to be favourable towards Telemedicine with most health care workers planning to make use of the technology in the next 12 months.

While the majority of the health care workers did consider themselves computer literate the level of computer literacy increased with the educational level of the health care workers. The largest computer illiterate group was found in the rural areas and among the nurses in the study.

The provincial Department of Health was perceived as supportive of Telemedicine while the local hospital management was found to be less so. Interestingly as the level of knowledge about Telemedicine increased among health care workers the level of perceived support from the provincial and local management was found to be more favourable.

Following from the discussion above the following 7 critical success factors were then identified in order to address the issues raised by the health care workers. The CSFs include:

- Implement and disseminate best practice within a legislative framework;
- Find a champion;
- Change management strategies;
- Training;
- Sustainable finance;
- Technical issues and
- Project management principles.

If these CSFs are addressed before and during the implementation of Telemedicine it will increase the acceptance and use of the technology among health care workers.

Finally these CSFs were sent to four experts in the field of Information Systems and IT in order to provide feedback and validate the results of this study. These two groups were identified as technical aspects to do with Telemedicine but the actual system had to be evaluated by the experts in order to ensure that the CSFs covered a broad range of factors. The overall feedback

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from the experts was positive and the recommendations made by these experts were incorporated into the final copy of the CSFs.

The research question and objectives posed in Chapter 1 of this study have now been met. In order to investigate the main research question three sub questions were identified. The CSFs stated earlier were developed in order to address these 3 sub questions in order to ensure the acceptance and use of Telemedicine by health care workers if incorporated correctly. The research questions and CSFs are identified and linked below.

Table 13: CSF and Research questions

Research question	CSFs
<i>1. What facilitating conditions are necessary for the adoption and continued use of Telemedicine in the Eastern Cape?</i>	• Implement and disseminate best practices within a legislative framework • Find a champion • Change management strategies • Training • Sustainable finance • Technical issues • Project management principles
<i>2. What effect does management support have on the decision to make use of Telemedicine?</i>	• Implement and disseminate best practices within a legislative framework • Find a champion • Change management strategies • Training • Sustainable finance

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	• Technical issues • Project management principles
3. <i>What role does previous exposure to Information Technology have on the user that will help predict the likelihood of Telemedicine being adopted and used?</i>	• Find a champion • Change management strategies • Training • Technical issues

8.7 FUTURE RESEARCH

This research project investigated the acceptance and use of Telemedicine among health care workers in the public sector of the Eastern Cape. The uses of Telemedicine were limited for the purpose of this study to clinical care and educational purposes and excluded patients' views of the technology.

Future Telemedicine research projects will have to investigate patients' views regarding the technology as even though Telemedicine is used to improve health care, patients themselves are rarely engaged in the decision making process regarding how the technology should be used to provide a service. If patients are consulted it is in the limited capacity of research subjects in 'satisfaction studies'. Patients must play a much broader role if Telemedicine is to be truly incorporated into health care. This then becomes a reason why patients and members of the community often resist new ICT services as they are rarely consulted in the decision making process regarding the reconfiguration of health care services including the use of Telemedicine. If patients are expected to become more involved with health care decisions, they must be included in the decision making processes regarding health care provision (Finch, Mort, May and Mair, 2005).

General research directions that must also be investigated include the testing of additional variables making use of the TAM and UTAUT models, testing the acceptance of Telemedicine on larger population sizes as well as longitudinal studies of the effects comparing technology

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acceptance among groups and individuals. More specific research questions include under specific circumstances do different TAM and UTAUT variables have a dominant impact on acceptance and use, what are the causes of TAM and UTAUT variables and how do these relationships differ depending on the stage of health technology implementations and the comparison from various theories to test the acceptance and use of technology in health care (Holden and Karsh, 2009).

8.8 LIMITATION OF STUDY

The study made use of self reporting methods to collect data. This method has been criticised in the literature because it assumes that self-reported usage will reflect actual usage. This is untrue as self-reported usage is known to be subject to method bias and will exaggerate the relationship between independent and dependent variables. It would be useful in future research to couple a survey type collection data tool with objective measures (Agarwal and Karahanna, 2000).

Other limitations of this study include the sample size ($n = 75$) which may not be enough to generalise the results to the general population. Future research must increase the sample size in order to make sure that the results will be able to provide adequate information regarding technology use among health care workers. Only one information system was investigated in this study. While the object of the study was to examine the user acceptance of Telemedicine there are other health information systems such as medical information systems and electronic documentation systems that can be included in this category. The private sector was not included in the study population as objective of Telemedicine will be different in this industry driven by profit.

8.9 SUMMARY

The research project identified the CSFs that must be present when Telemedicine is implemented in order to increase user acceptance and use of the technology. As the initial rollout of Telemedicine is considered very expensive every effort must be made to guarantee that it will be used to its full potential once it is in place. The identification of the CSFs then improves the success rate of the technology and provides valuable insight into the acceptance behaviour of health care workers in the public service of a developing country. The value of the

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study is determined by the contribution it makes to the existing literature that is available on the topic and especially so in South Africa where very little original research is available in general.

The CSFs can be used by policy makers and the implementers of the technology when rolling out Telemedicine to improve health care service in rural areas. This has the potential to improve the quality of the services provided as well as making it more accessible. Overall, Telemedicine is a very important technology that must be considered by developing countries to improve their health care services but the resources necessary can only be committed if the investment provides the advantages it promises. With the introduction of these CSFs this is now possible and will enable the user acceptance and use of Telemedicine in developing countries.

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Addendum 1

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7. Which of the following describes your place of work?

- a. Clinic
- b. Community health center
- c. District hospital
- d. Regional hospital
- e. Secondary hospital
- f. Other _____

8. How often do you use Telemedicine?

- a. None
- b. Monthly
- c. Weekly
- d. Daily

9. How often do you use computers in general?

- a. None
- b. Monthly
- c. Weekly
- d. Daily

10. How would you describe your knowledge of Telemedicine in general?

- a. Not knowledgeable
- b. Somewhat knowledgeable
- c. Knowledgeable
- d. Very knowledgeable

SECTION 2

Please indicate the degree to which you agree or disagree with the following statements as they relate to using Telemedicine

1 – Strongly disagree

3 - Agree

2 – Disagree

4 – Strongly agree

Perceived Usefulness

1. Using Telemedicine improves the quality of the work I do	1	2	3	4
2. Using Telemedicine gives me greater control over my work	1	2	3	4
3. Telemedicine enables me to accomplish tasks more quickly	1	2	3	4

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4. Telemedicine supports critical aspects of my job	1	2	3	4
5. Using Telemedicine increases my productivity	1	2	3	4
6. Using Telemedicine improves my job performance	1	2	3	4
7. Using Telemedicine allows me to accomplish more work than would otherwise be possible	1	2	3	4
8. Using Telemedicine enhances my effectiveness on the job	1	2	3	4
9. Using Telemedicine makes it easier to do my job	1	2	3	4
10. Overall, I find Telemedicine useful in my job	1	2	3	4

Adopted from Davis, 1989

Perceived ease of use

1. I find it cumbersome to use the Telemedicine system	1	2	3	4
2. Learning to operate the Telemedicine unit is easy for me	1	2	3	4
3. Interacting with the Telemedicine system is often frustrating	1	2	3	4
4. I find it easy to get the Telemedicine system to do what I want it to do	1	2	3	4
5. The Telemedicine system is rigid and inflexible to interact	1	2	3	4

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with				
6. It is easy for me to remember how to perform tasks using the Telemedicine system	1	2	3	4
7. Interacting with the Telemedicine system requires a lot of my mental effort	1	2	3	4
8. My interaction with the Telemedicine system is clear and understandable	1	2	3	4
9. I find it takes a lot of effort to become skilful at using the Telemedicine system	1	2	3	4
10. Overall, I find the Telemedicine system easy to use	1	2	3	4

Adopted from Davis, 1989

Acceptance and Use of Technology

Performance Expectancy				
1. I find Telemedicine useful in my job	1	2	3	4
2. Using Telemedicine enables me to perform tasks more quickly	1	2	3	4
3. Using Telemedicine enables me to be more productive	1	2	3	4
4. If I use Telemedicine, I will increase my chances of getting a salary increase	1	2	3	4
Effort Expectancy				
1. My interactions with the Telemedicine system is clear and understandable	1	2	3	4
2. It was easy for me to become skilful at using the Telemedicine system	1	2	3	4
3. I find the Telemedicine system easy to use	1	2	3	4

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4. Learning to operate the Telemedicine system is easy for me	1	2	3	4
Social influence				
1. People who influence my behaviour think I should use Telemedicine	1	2	3	4
2. People who are important to me think I should use Telemedicine	1	2	3	4
3. The senior management of my institution have been helpful in the use of Telemedicine	1	2	3	4
4. In general the DoH has supported Telemedicine	1	2	3	4
Facilitating conditions				
1. I have the resources necessary to use Telemedicine	1	2	3	4
2. I have the knowledge necessary to use Telemedicine	1	2	3	4
3. Telemedicine is not compatible with other systems I use	1	2	3	4
4. There is a specific person allocated for assistance if I experience system difficulties	1	2	3	4
Attitude towards the system				
1. Making use of Telemedicine is a good idea	1	2	3	4
2. Telemedicine makes work more interesting	1	2	3	4
3. I like working with the Telemedicine system	1	2	3	4
4. I feel apprehensive toward using Telemedicine	1	2	3	4
5. I hesitate using Telemedicine for fear of making mistakes I cannot correct	1	2	3	4

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Behavioural intention				
1. I intent to use Telemedicine in the next 12 months	1	2	3	4
2. I predict I will use Telemedicine in the next 12 months	1	2	3	4
3. I plan to use Telemedicine in the next 12 months	1	2	3	4

Adopted from Venkatesh, 2003

SECTION 3

Computer literacy

1. Do you consider yourself computer literate?	Yes	No
2. Do you use a computer for official use?	Yes	No
3. Do you use a computer for personal use?	Yes	No
4. Do you make use of e-mail?	Yes	No
5. Do you make use of a digital camera to take pictures?	Yes	No
6. Are you familiar with Microsoft Word?	Yes	No
7. Are you familiar with Microsoft Excel?	Yes	No
8. Do you know how to save a document?	Yes	No

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9. Do you know how to attach a document to an e-mail?	Yes	No
10. Have you received any formal computer training?	Yes	No

SECTION 4

Please indicate which of the following Telemedicine modalities you have made use of in the past:

Modality	Never	Seldom	Often	Daily
SMS/MMS				
Telephonic conversations				
E-mail				
E-mail with photographs attach				
Real time system (PC, camera)				
Other (please specify)				

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