# USER ACCEPTANCE OF TELEMEDICINE BY HEALTH CARE WORKERS A CASE OF THE EASTERN CAPE PROVINCE, SOUTH AFRICA

**Liezel Cilliers**
University of Fort Hare
East London, South Africa
lcilliers@ufh.ac.za

**Stephen Flowerday**
University of Fort Hare
East London, South Africa
sflowerday@ufh.ac.za

**ABSTRACT**
The Eastern Cape province of South Africa is one of the poorest provinces in the country with vast rural areas. A telemedicine system was implemented in the province in order to improve health care services. Despite large investments from the National Department of Health, only a third of telemedicine sites in the province are operational. Technology problems, such as unreliable electricity supply and low bandwidth, was identified as barriers to the successful implementation of telemedicine in South Africa, but these issues have since been addressed. Nevertheless, the uptake of telemedicine remains poor. One of the documented barriers to the successful implementation of telemedicine is user acceptance by health care workers. This study made use of the Technology Acceptance Model (TAM) to identify the factors that influence the user acceptance of telemedicine among health care workers in a developing country such as South Africa. The study used a quantitative survey approach. A questionnaire was distributed to all the hospitals and clinics around the province where telemedicine had been implemented. The results were analyzed using SPSS 20 and the conclusions drawn from the results were presented to five experts in the field of telemedicine and Information Systems. In general, the attitude of the health care workers was positive towards telemedicine, although the present usage of the system was low. Health care workers, especially those in the rural areas, perceived the telemedicine system to be useful to improve the quality of health care services they provide. The perceived ease of use of the telemedicine system was influenced by both the educational qualification and area in which the health care workers worked. Those that did not complete high school and worked in rural areas were apprehensive about using the telemedicine system. However, the majority of the health care workers indicated that they did plan to make use of the telemedicine system in the future. Interventions focused on education should be specific for rural or urban areas. In rural areas education should focus on computer literacy skills and how to use the telemedicine system, while in urban areas the awareness of the telemedicine should be increased.

**KEYWORDS:** Telemedicine; South Africa; Health Care Workers; Technology Acceptance Model; Critical Success Factors

## 1. INTRODUCTION

Information systems have the potential to reduce the impact of the disparity in health care that is found between urban and rural areas. In order to better coordinate and thus improve health care services information systems provide the tools to capture, store, process and communicate health care information. These tools are especially beneficial in rural areas (Fichman, Kohli, Krishnan, & Kane, 2011). The World Health Organization (WHO) has identified telemedicine as a possible information system that can simultaneously improve the quality and reduce the cost of health care (WHO, 2011). Telemedicine, meaning medicine at a distance, makes specialized health care services more accessible in the rural areas. Patients in rural areas do not have to travel long distances to urban hospitals in order to access specialist care, while waiting times and transportation costs are reduced (Wooton, Patil, Scott, & Ho, 2009).

The Eastern Cape Province has consistently recorded the highest number of neonatal deaths in South Africa during the past 5 years. Furthermore, the doctor: patient ratio in parts of the Eastern Cape is 14 times below the national standard reported for South Africa (National Perinatal Morbidity and Mortality Committee, 2011; IRIN, 2008). Reasons for these statistics include poor access to health care as well as the quality of health care services in rural areas (Nwabueze, Meso, Kifle, Okoli, & Chustz, 2009). The National Department of Health, in line with the WHO, has made the decision to include telemedicine as an integral part of the E-health plan in South Africa. In order to overcome cost and connectivity problems, the store and forward approach was introduced in the Eastern Cape. For this approach all that is needed is a basic computer with Internet connectivity and a digital camera. An e-mail message is send to the specialist in the urban health care facility that can be reviewed and replied to at their convenience (Singh, 2009).

Despite the investment of the National Department of Health to implement telemedicine in the province, only a third of telemedicine sites were operational in 2010. The availability of appropriate technology and user acceptance by health care workers is considered to be two of the key reasons why telemedicine project fail (Nwabueze, Meso, Kifle, Okoli, & Chustz, 2009; Lewin Group, 2000). The technology has been made available in the province since 2005, but the user acceptance of the health care workers toward telemedicine has not been investigated to date in the Eastern Cape Province.

Using the case of the Eastern Cape in South Africa, this study aims to investigate the factors that influence user acceptance of telemedicine among health care workers in a developing country making use of the Technology Acceptance Model (TAM). The rest of the article is divided into the following sections. Section 2 provides an overview of the context in which the telemedicine system was implemented; Section 3 provides the theoretical framework of the study while Section 4 discusses the methodology used in this study. Section 5 will analyze the results of the study while section 6 provides a discussion of the results. Finally, Section 7 concludes the article.

## 2. BACKGROUND TO THE PROBLEM

Telemedicine can be used to expand access to and improve primary and secondary health care services (Wooton et al, 2009). According the Sorenson (2010), telemedicine can be used to provide clinical services; distance education; telemonitoring as well as peer support for health care workers. Benefits of telemedicine include (Mars, 2013; Fichman et al, 2011):

- o Increased quality of care – increased access to specialized services with fewer unnecessary referrals to urban hospitals;
- o 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; and
- o Decreased isolation of health care workers – providing educational and supervisory opportunities in rural areas in order to continue professional development.

South Africa consists of nine provinces, of which the Eastern Cape is the second largest province in terms of geography and the third largest province in terms of population. The province is home to approximately 6.7 million people, representing 13% of the total population in the country (ECSECC, 2012). The Eastern Cape is one of the poorest provinces in South Africa with a 57% poverty rate and 30.4% unemployment rate (StatsSA, 2012; ECSECC, 2012). It is estimated that 63% of the population in the province lives in rural areas where inferior infrastructure, low income, poor social conditions, unreliable water supply, and poor access to health facilities are at the order of the day (ECSECC, 2012).

To improve health care in the rural area of South Africa, the National Department of Health has invested R15 million in telemedicine so far, but only 34% of the telemedicine projects initiated in the country were operational in 2010 (Van Dyk, Fortuin, & Schutte, 2012; Motsoaledi, 2010). In the Eastern Cape, telemedicine was introduced at six district hospitals and 25 clinic sites since 2005. The pilot sites have not produced the desired results, and after an investigation, it was found that the technology was underutilized or not used at all in some facilities (Telemedicine Operation Plan E-health, 2009).

The Eastern Cape is not unique in this respect, as South Africa has had little success with telemedicine in general (Mars, 2012). Barriers to the implementation of the technology included unreliable electricity supply, poor Internet connectivity and low bandwidth (Mars, 2013; Van Dyk, Fortuin, & Schutte, 2012; Mars, 2012; Jack & Mars, 2008). Internet penetration in Africa is the lowest of all the developing world regions with only 0.3% fixed broadband penetration on the continent and Internet penetration at 16.3% (Mars, 2013). Telecommunication costs are considered to be very high with 14 of the 20 most expensive countries located in Africa (International Telecommunications Union, 2012). Reasons provided for these barriers include the poor telecommunication infrastructure in Africa caused by the long history of civil unrest and war in various African countries. Collier (2007) estimates that for each year of civil unrest or war in a country, the economy and infrastructure is set back by up to seven years.

Human barriers to the adoption of telemedicine that has been identified in recent years include human and organizational factors (Mars, 2012). These factors include the shortage of staff in rural health care centers and the extra steps that telemedicine introduce in the clinical workflow. Although beneficial for patients, telemedicine does add to the work load of already overburdened health care workers (Mars, 2013). Additionally, Mars (2013) identified that many health care workers are not aware of the technology or the benefits it can provide. Health care workers also raised concerns about the liability, jurisdiction and remuneration that must be considered when telemedicine is offered across country borders. In addition, there are concerns about the clinical quality and continuity of care, confidentiality of the patient and how the data transmitted is secured. To address some of these issues, the Health Professions Council of South Africa was tasked to provide a 'Guideline for the Practice of Telemedicine' in 2005. The guideline has not been completed as of yet.

One of the factors that have been identified as possible obstacles for the successful implementation of telemedicine is user acceptance (Nwabueze et al, 2009; Pagliari et al., 2005). The implementation approach of the National Department of Health thus far has been 'if you put it in place they will use it', but it is not sufficient to understand the complex human, management and cultural factors that need to be taken into account when implementing telemedicine in a developing country (Mars 2013). The Lewin Group (2000) has suggested that user acceptance by health care workers was the second largest threat after the availability of appropriate technology to the successful implementation of telemedicine. This was supported in subsequent years by Pagliari et al., (2005) and Nwabueze et al (2009) who found that user acceptance can be an obstacle to the acceptance and continued use of telemedicine. Furthermore, the context into which the new technology is introduced, cultural factors and the efficacy of the technology transfer was found to influence the perceived value of the technology (Nwabueze et al, 2009). Further factors that are reported to be barriers to user acceptance of telemedicine include a lack of a change management plan, no business model, limited buy-in from health care workers, high staff turnover and limited eReadiness (Mars, 2013). Education has been suggested as a possible solution to prepare the health care worker for the new technology. If the health care workers are educated about the purpose and benefits of the telemedicine system they are more likely to make use of it. Similarly, the computer literacy skills of the health care workers must be taken into consideration when a

telemedicine system is implemented, as this can often be a barrier to the use of the system (Cilliers & Flowerday, 2012). The benefits provided by telemedicine are well documented in literature, but to achieve these benefits, the technology must be accepted by the end users and utilized optimally. The next section will discuss the theoretical framework used in this study.

## 3. THEORETICAL FRAMEWORK

Technology Acceptance Model (TAM) was chosen as the underlying theoretical background for this study. TAM can be used to predict technology use and acceptance. TAM was originally developed by Davis in 1986 and is one of the most cited theoretical frameworks in Information Systems (Davis, 1989). The model has been used extensively to evaluate technology in the health care sector and record the unintended consequences of poor implementation of telemedicine. Holden & Karsh (2009) reports that limited use of or resistance toward new technology, workarounds and overrides, sabotage and abandonment are activities frequently found when new technology is implemented into health care. This denotes that the success of a telemedicine system will be determined by the end users, making TAM appropriate for this study. TAM is used to depict the perceived usefulness and perceived ease of use which will ultimately determine the user's intention to make use of new technology and can therefore be used to predict and validate factors that will influence technology adoption, acceptance and use (Teo, 2009).

TAM is based on four factors according to Davis (1989). Perceived ease of use of a system is the degree to which a person believes that using a particular system would be free of effort. Perceived usefulness of a system is defined as the degree to which a person believes that using a particular system would enhance his or her job performance or increases their productivity, quality of care, effectiveness and overall service (Tulu, Horan, & Burkhard, 2005). Perceived ease of use is not likely to affect acceptance, but it does appear to correlate with usefulness. Tulu, Horan, & Burkhard (2005) and Chismar & Wiley-Patton (2003) found that health care workers will adopt technology if it is beneficial to the patient even though it might not be easy to learn how to operate the information system. This would explain why literature reports perceived usefulness and not perceived ease of use to be critical within this user group. Behavioral intention to use the system is the individual's interest in using the system for future work actual system use.

Venkatesh, Morris, Davis & Davis, (2003) stated that one of the limitations of TAM is that it only helps the user to understand and explain acceptance making use of the system characteristics such as ease of use and usefulness. The model is less useful to guide development of new technology beyond these two characteristics. Also, the assumption 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 of the user, time, environmental and organizational limits or unconscious habits will limit the health care worker to make use of the technology. However, for the purpose of this study, TAM was found to be sufficient as health care workers are reported to be more pragmatic than other user groups when accepting new technology.

## 4. METHODS AND METHODOLOGY

This research study uses a positivistic paradigm. The research methodology that was used is a quantitative survey design. The questionnaire was adapted from the original questionnaire designed by Davis (1989) to test technology acceptance. The questions were adapted to reflect the telemedicine context of this study, and a Likert scale was used to measure the responses of the health care workers. This questionnaire has been verified and found to be acceptable for the testing of acceptance of new technology by users in different settings (Venkatesh et al, 2003).

The study population of this research study was limited to health care workers employed at any of the Eastern Cape Department of Health telemedicine sites within the province. A pilot study was conducted at a secondary hospital to determine the ambiguity of the questions. The questionnaire was distributed to 15 health care workers in the hospital who reported that the questions were clear and unambiguous. The final questionnaire was distributed from April to June 2010 in a hardcopy format to 75 participants working in the 6 hospitals and 25 clinic sites where telemedicine was implemented in the province. A random selection method was used to distribute the questionnaire to the multidisciplinary team including nurses, doctors, dentists and radiologists at all the urban and rural telemedicine sites in the province.

Statistical Package for the Social Sciences (SPSS 20) was used to analyze the data that was collected. Demographics of the participants were displayed making use of illustrative statistics while the chi-square statistical test was used to perform the statistical analysis. Exclusion criteria for this study included telemedicine systems implemented in the private sector and technology problems e.g. internet connectivity and electricity interruptions, which could deter telemedicine usage. Validity of the results were ensured making use of a variety of data collection methods (questionnaire and literature review), all conclusions and recommendations were explained making use of the data collected and validated through an expert review process. The reliability of the results was provided making use of a detailed explanation of the research design and process to enable future researchers to follow a similar research framework.

An expert review seeks to determine if the data that is available, support the proposed solution (Klein & Richey, 2007). After the results had been analysed, the discussion was sent to five South African experts in the field of Information Systems and telemedicine in order to provide feedback and validate the conclusions that was drawn from the results. The five experts provided expertise and skills in both the technical and information system spheres of telemedicine.

## 5. RESULTS

### 5.1 Demographics

The return rate of the questionnaire was 76%. The study participants indicated that 43,9% worked in an urban setting and 56,2% in a rural area. The educational level of the participants included 62% who obtained a formal qualification, 22% completed high school (Grade 12) and 14% who did not completed high school, but only completed Grade 10.

**Table 1: Demographics of participants**

| | | |
|---|---|---|
| **Urban area** | | 43.9% |
| **Rural area** | | 56.2% |
| **Educational level** | Post high school qualification | 62% |
| | Completed high school (Grade 12) | 22% |
| | Did not complete high school, but completed Grade 10 | 14% |

The following section provides insight into the perceived usefulness, perceived ease of use, actual use of the system and behavioural intent of the respondents.

### 5.2 Perceived Usefulness

In this study, 82% of the respondents perceived telemedicine as a useful technology. Figure 1 represents the various aspects of perceived usefulness of telemedicine as reported by the respondents in their daily activities.

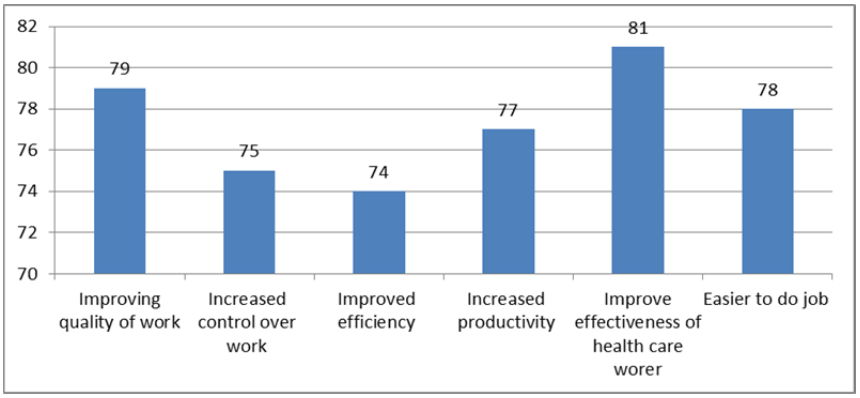


**Figure 1: Percentage of perceived usefulness of telemedicine**

The setting of the workplace tested statistically significant for two questions in this category. These two questions were "Using telemedicine gives me greater control over my work" ($\alpha$ =26,882; $p<0,05$) and "Overall, I find telemedicine useful in my job" ($\alpha$ =21,884; $p<0,05$) The health care workers in the rural areas (clinics, community health settings and district hospitals) perceived telemedicine to be more useful (average = 91%) than those working in the secondary hospitals in the urban area (54%).

### 5.3 Perceived Ease of Use

While the majority of respondents in this study indicated that telemedicine (84,2%) would improve service delivery, there was still considerable apprehension (40,3%) and fearfulness (31,6%) when using the system. Feeling of apprehension when making use of the system tested statistically significant for qualification ($\alpha$ =26,756; $p<0,05$) and area of facility ($\alpha$ =24,485; $p<0,05$). The user group most prone to apprehension was those with lower educational qualifications as shown in Figure 2. This can be explained as those categories of health care workers are least exposed to Information and Communication Technology (ICT) and unable to access assistance with the technology when needed.

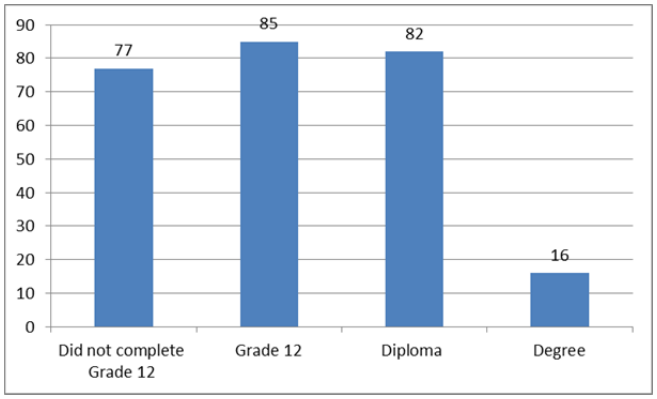


**Figure 2: Qualification and feeling of apprehension in health care workers**

Both the qualification and setting of workplace tested statistically significant for the perceived ease of use of telemedicine. The respondents in the rural areas found it more

difficult to make use of the telemedicine system (70%), while those in the urban area only recorded a 50% difficulty rate ($\alpha$ =15,287; p<0,05). For the question "I find it cumbersome to use the telemedicine system" it was found that there was a direct correlation between the qualification of the health care worker and ease of use of the telemedicine system ($\alpha$ =17,830; p<0,05). The respondents with a high school education found the system the most cumbersome to use (80%), followed by those with a diploma qualification (68%) and a degree qualification (33%).

### 5.4 Behavioral Intent

Following on from the previous section, behavioural intent towards the technology was found to be very favourable. Most of the respondents (70,2%) indicated favourably that they would be making use of the system in the next 12 months. Behavioural intent was statistically significant for both the predicted ($\alpha$=16,139; p<0,05) and planned ($\alpha$ =22,163; p<0,05) use of telemedicine during the next 12 months.

### 5.5 Actual use of the system

While 42% of health care workers indicated that they do use the system on a daily basis, a third of the study population indicated that they do not use the system at all. Telephonic conversations are the most frequently used (43.9%) because it is freely available in a variety of settings (both urban and rural) and can be used for immediate feedback.

## 6. DISCUSSION

Siracuse & Sowell (2008) posit that perceived usefulness of a telemedicine system had the most significant influence on intention to use and actual technology usage. This is supported by Holden and Karsh (2009) who concluded that for new technology to be accepted by health care workers, it must be perceived as useful and not necessarily easy to use. The majority of respondents in this study indicated that the telemedicine system enhanced their job performance and productivity. More than 80% indicated that using the system improved the effectiveness of the health care worker.

The respondents working in the rural areas found the telemedicine system was more useful to execute their daily activities than those working in urban areas. Rural health care facilities benefit the most from telemedicine because the patients can be referred to specialists without the inconvenience of travelling. Further, 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. Health care workers in urban areas did not find telemedicine as useful to perform their daily activities. Possible reasons for this result could be that telemedicine was perceived as an additional activity or responsibility that had to fit into an already busy workload, or a lack of awareness regarding the role and benefits of telemedicine.

Perceived ease of use, according to literature, is not likely to affect acceptance of telemedicine as health care workers will adopt new technology if it is perceived to be beneficial to the patient (Tulu, Horan, & Burkhard, 2005). According to Holden and Karsh (2009), health care workers are more computer literate than the general population, and therefore can learn how to operate the telemedicine system with ease. This held true in this study for health care workers with a high school qualification or degree. The assumption is that these workers had greater exposure to ICTs during their education. The health care workers in the rural areas and with the lowest qualifications were the most apprehensive to use the system and found the system the most difficult to use. Health care workers in the rural areas are expected to be less computer literate than their counterparts in the urban areas as their access to ICTs are limited. Coleman (2013) found that many health care workers in rural

areas do not use computers as part of their work activities. Further findings indicated that many rural health care workers do not have the necessary computer skills or experience with ehealth applications such as telemedicine. Access to computers further compounded this problem as health care workers in rural health facilities do not have access to computers to improve computer literacy skills. Asah (2013) stated that the lack of computer infrastructure in rural areas is a barrier to accessing ICTs in developing countries. In addition, computer literacy education is not focused on task specific activities for health care workers, but rather generic computer programmes, leaving health care workers unable to transfer skills from one software program to another. Health care workers in urban areas also have better support services available to them that assist them to use the telemedicine system. The lack of exposure to ICTs and technical assistance, if required, contributed to the apprehension of the health care workers.

During the expert review process, the above conclusion were confirmed as the experts stated that the usefulness and ease of use of a telemedicine system is relative to the qualifications and place of work as health care workers in rural and urban areas present with different characteristics. Lack of ICT infrastructure and computer literacy skills are common place in rural health care facilities, while urban health care workers do not value the benefits of telemedicine. Therefore, in rural areas, education should be focused on computer literacy skills and how use the telemedicine system, but in urban areas, educational efforts should be focused on increasing the awareness of the telemedicine system among health care workers.

## 7. CONCLUSION

The study investigated the factors that contribute to the user acceptance of telemedicine in the Eastern Cape Department of Health. The majority of the health care workers making use of telemedicine perceived the technology as useful and indicated that they expected telemedicine to improve their productivity. The aim of a telemedicine system is different for the rural and urban health care facility. In rural areas the telemedicine system facilitates access to specialist care, and saves the patient traveling costs. It also provides the rural health care workers with an opportunity to learn from their urban counterparts. The rural health care workers found the system difficult to operate, possibly due to the lack of computer literacy skills and ICT support. In conclusion, the factors that influenced the user acceptance of telemedicine in the Eastern Cape Province include for perceived usefulness the location of the work place (rural or urban) of the health care workers; and for perceived east of use those health care workers with lower qualifications and, similarly to perceived usefulness, the location of the work place. The results showed that while the technology was considered favourably by the health care workers, there were implementation problems regarding the infrastructure, assistance with the technology, and computer literacy among staff working with the system. These problems must be addressed to ensure the proper use and return on investment for telemedicine.

The limitations of the study include the use of self reporting methods to collect data and the small sample size. Self-reporting methods, such as questionnaires, have been criticised in the literature because of the assumption 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. In future research a questionnaire could be used together with an interview to address this concern. The small sample size may not be large enough to generalise the results to a broader 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. A comparison between different provinces of South Africa could also be of value. A further suggestion for future research includes the acceptance of patients of telemedicine. Patients 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.

**ACKNOWLEDGMENT**

This study was undertaken with the permission of the Department of Health.

This paper is based research that was conducted for a MCom (Information Systems) degree at the University of Fort Hare. The first paper that was published from this research can be cited as follow:

Cilliers, L., & Flowerday, S. (2012). Technology acceptance of telemedicine in the Eastern Cape Department of Health. *IST-Africa* (1-7). Dar Es Salaam: IST-Africa.

## 8. REFERENCES

Asah, F. (2013). Computer usage among nurses in rural health-care facilities in South Africa: obstacles and challenges. *Journal of Nursing Management, 21(3)*, 499-510.

Chismar, W., & Wiley-Patton, S. (2003). Does the extended technology acceptance model apply to physicians. *36th Annual Hawaii International Conference* (p. 8). Hawaii: System Sciences.

Cilliers, L., & Flowerday, S. (2012). Technology acceptance of telemedicine in the Eastern Cape Department of Health. *IST-Africa* (pp. 1-7). Dar Es Salaam: IST-Africa.

Coleman, A. (2013). Using a virtual ICT training framework to support doctors in rural hospitals in South Africa. *Ethno Med, 7(3)*, 137-141.

Collier, P. (2007). *The Bottom Billion.* Oxford: Oxford University Press.

ECSECC. (2012). *Eastern Cape Development Indicators.* http://www.ecsecc.org/files/library/documents/EasternCape_withDMs.pdf

Fichman, R., Kohli, R., Krishnan, R., & Kane, G. (2011). *The role of Information Systems in healthcare: current research and future trends.* Information Systems Research.

Holden, R., & Karsh, B. (2009). The Technology Acceptance Model: Its past and its future in health care. *J Biomed Inform*, doi:10.1016/j.jbi.2009.07.002.

International Telecommunications Union. (2012). *Measuring the information society.* Geneva: ITU.

IRIN. (2008). *South Africa wanted - 4000 doctors*. Plusnews: http://www.plusnews.org/Reports/79241/SOUTH-AFRICA-WANTED-4000-DOCTORS .

Jack, C., & Mars, M. (2008). Telemedicine a need for ethical and legal guidelines in South Africa. *South African Family Practice, 50*, 60-10.

Klein, J., & Richey, R. (2007). *Design and development research.* New Jersey: Lawrence Erlbaum Associates.

Lewin Group. (2000). *Assessment of approaches to evaluating telemedicine final report.* USA: Office of the Assistant Secretary for Planning and Evaluation, Department of Health and Human Services.

Mars, M. (2012). Telepsychiatry in Africa - a way forward. *African Journal of Psychiatry, 15*, 215-217.

Mars, M. (2013). Telemedicine and advances in urban and rural healthcare delivery in Africa. *Progress in cardiovascular diseases, 56(3)*, 326-335.

Motsoaledi, M. (2010). *2010 Speaking notes for Dr AP Motsoaledi - Keynote address*. http://www.dogh.gov.za/show.php?id=2104

National Perinatal Morbidity and Mortality Committee. (2011). *National Perinatal mortality and morbidity committee triannual report (2008-2010).* Pretoria: Department of Health.

Nwabueze, S., Meso, N., Kifle, C., Okoli, C., & Chustz, M. (2009). The effects of culture of adoption of Telemedicine in medically underserved communities. *42nd International Conference on System Sciences* (pp. 1-10). Hawaii: International Conference on System Sciences.

Pagliari, C., Sloan, D., Gregor, P., Sullivan, F., Detmer, D., Kahan, J., et al. (2005). What is eHealth (4): A scoping exercise to map the field. *J Med Internet Res, 7(1)*, 201-210.

Singh, V. (2009). *Telemedicine and mobile telemedicine system*. http://works.bepress.com/vikas_singh

Siracuse, M., & Sowell, J. (2008). Doctor of pharmacy students' use of personal digital assistants. *Am J Pharm Educ, 15*, 72-75.

Sorenson, T. (2010). *MTN Foundation South Africa Telemedicine Conference.* Cape Town: MTN.

Statistics South Africa. (2011). *Quarterly Labour Force Survey: Quarter 3 (July to September)* . Pretoria: Statistics South Africa.

StatsSA. (2012). *Key Results - Census 2011.* Retrieved November 12, 2012, from http://www.statsssa.gov.za/Census2011/.../Census_2011_Key_Results.pdf

Telemedicine Operational Plan E-health. (2009). *Operational Plan for Eastern Cape*. http://ecdoh.gov.za/uploads/files260308124225.pdf

Teo, T. (2009). Modelling technology acceptance in education: A study of pre-service teachers. *Computers and Education Numbers, 52*, 302-312.

Tulu, B., Horan, T., & Burkhard, R. (2005). Dimensions of work practice compatibility and influences on actual system use: examining physician use of online disability evluation system. *Eleventh Americas Conference on Information Systems* (pp. 1-11). Omaha: Americas Conference on Information Systems.

Van Dyk, L., Fortuin, J., & Schutte, C. (2012). A maturity model for telemedicine implementation. *The Fourth International Conference on e-Health, Telemedicien and Social Medicine* (pp. 69-71). Cape Town: eTelemed.

Venkatesh, V., Morris, M., Davis GB, & Davis, F. (2003). User acceptance of information technology: toward a unified view. *MIS Quarterly, 27*, 425-427.

WHO, (2011). *What is eHealth: the World Health Organisation (WHO) definition*. Http://ehealthexpert.org/defehealth

Wooton, R., Patil, N., Scott, R., & Ho, K. (2009). *Telemedicine offers solutions for Telehealth in the developing world.* London: Royal Soceity of Medicine Press.