

The utilization of mobile devices for telemedicine services in a South African public healthcare system

André HARTMANN ^{a,1} and Liezl VAN DYK ^b

^a*Department for Industrial Engineering, Stellenbosch University*

^b*Programme for Industrial Engineering, North-West University*

Abstract. The purpose of this study is to develop an understanding in the use of mobile devices in administering telemedicine services within the public health care sector of South Africa. An online questionnaire was developed and distributed amongst medical officers, specialists, students and medical staff of one of the health districts of South Africa. This paper describes the design of the questionnaire as well as the most significant outcomes. Results are presented in terms of reasons why healthcare workers use mobile devices, as well as perceptions in terms of transmission security and quality of transmitted information.

Keywords. Telemedicine, mobile device, public healthcare, South Africa

Introduction

The South African public health care system has been struggling to provide the most basic health care services to the South African population. Additional strain is placed on the system due to the rural nature and the financial inequality of the country. Telemedicine has the unique potential to fundamentally improve the South African public health care system. It can do so by establishing a health care system which provides equitable access to quality health care services to all South Africans [1–3].

Advances in the information and communication technology (ICT) sector, the African mobile phone revolution, and the introduction of telemedicine, can provide the appropriate means to battle the issues faced by the public health care sector [4]. Telemedicine is a rapidly developing applicator of clinical medicine. “mHealth”, which is the application of telemedicine services by means of mobile devices, is leading the way in the advances being made in the application of health care in South Africa [5–7].

Telemedicine services and mhealth applications are being implemented more frequently in the public health care sector of South Africa. The volume of available literary information which pertains to the success or functionality of such services and applications in a South African context is insufficient [1,8]. There is a great lack of understanding in the utilisation of mobile devices in conjunction with telemedicine

¹ Corresponding Author: Andre Hartmann, Department for Industrial Engineering, Stellenbosch University, Private Bag X1, Matieland, Stellenbosch, 7602, South Africa; Email: Liezl.VanDyk@nwu.ac.za

services.

The purpose of this study is to develop an understanding in the use of mobile devices in administering telemedicine services within the public health care sector of South Africa.

This paper is structured as follows: First, the method section elaborates on the construction and distribution of the questionnaire, which was utilized to attain the relevant information which pertains to mobile devices in the public health care sector of a South African province. Secondly, the outcomes of the questionnaire are presented in the results section, which are followed by a brief discussion of the results.

1. Methodology

The online "Use of Mobile Devices in Health Care" questionnaire was constructed with the purpose of obtaining information on the utilisation of mobile devices in the public health care sector. The questionnaire was run over a period of six weeks in conjunction with a research study which assessed the maturity of telemedicine services in that region [9]. The Stellenbosch University Health Research Ethics Committee (HREC) approved the questionnaire based on the ethical clearance which was granted for the overarching research study.

1.1. Questionnaire Design

The construction of a questionnaire involves a certain procedure, which includes considering research questions, defining a target population and finally formulating the questions themselves [10].

The questionnaire was thus structured according to the 5M's of manufacturing, namely man, machine, method, money and material (refer to Table 1). Applying the 5M's of manufacturing to mhealth services may seem inappropriate at first, however, the generic description associated with manufacturing processes are similar in nature to those of a telemedicine service. For instance, each mhealth service consists of a wide range of users which interact with the telemedicine system or service (man), using a certain device or platform (machine) to exchange medically relevant patient information (material). These interactions are ideally governed by previously agreed upon work protocols and policies (method), and funded by appropriate financial structures (money). Man, machine, material, method and money are thus defined as the 5 domains which make up a telemedicine service [11].

1.2. Target Populations

The research questions listed in Table 1 and the purpose of the questionnaire provide a clear indication as to the composition of the intended target population. The definition of the target population is of importance as it affects the level and type of the response information extracted. The target population was thus defined to include health care workers and health care professionals who are employed or active in the public sector (i.e. Administrative Staff, Community Service Doctor, Intern, Managerial Staff, Medical Officer, - Specialist, - Student and Nurse).

1.3. Distribution of Questionnaire

Six regional and district telemedicine co-ordinators of one of South Africa's provincial health systems assisted in the electronic distribution by e-mailing the description of the study, together with the questionnaire URL to respective staff and colleagues. This enabled the collection of independent telemedicine service data.

Although this method of distribution provided an efficient, timely and cost effective means of collecting relevant telemedicine data, control over the recipients of the questionnaire was lacking. The resulting composition of the sample demographic was thus unclear and had to be determined once the data collection had been concluded.

Table 1. Questionnaire Design

Category	Questions
Demographics	What is the job title for your current position? What is your gender? What is your age? What is the highest level of education you have completed? Number of years (health care sector) work experience? What is the name of the Health Care Facility you are currently working at? What type of Health Care Facility do you work at?
Man	What will motivate you to use mobile devices for Health Care purposes?
Machine	Do you use your mobile device to capture, document or transmit medical data? Which type of mobile device are you currently using? Which operating system does your mobile device use? Which mobile service provider do you subscribe to? How would you rate your mobile device signal coverage? Did you purchase your mobile device with the intention of using it in the health care sector? Do you use your mobile device to assist you in your work, by attaining information via the internet?
Material	How do you capture or document medical data with your mobile device? How do you transmit/receive medical information/data via your mobile device?
Method	Does the protocol you follow when using your mobile device deviate from the standard protocol? If yes, are the new protocol formalized in your institution? Does the Health Care Facility you work at have a mobile device policy?
Money	Who purchased your mobile device? Who carries the operating costs of your mobile device? Do you receive any reimbursement for the use of mobile devices to you in your work?

1.4. Demographics of Respondents

An analysis of the demographic data concluded that the gender distribution of the sample was approximately two thirds male (69 percent) and one third female (31 percent). The dominant age group was composed of health care workers aged 25-to-35. A lack of respondents in the age group 65-and-older confirmed that the intended target population, ranging from medical students to medical specialists active in the public health care sector, composed the sample. It can therefore be concluded that the sample of the "Use of Mobile Devices in Health Care" questionnaire is representative of a

predominantly male health care workforce aged from 25-to-44, which is an accurate representation of the current public health care sector of the Western Cape.

Previous studies indicated that telemedicine services implemented in the public health care sector of the Western Cape are predominantly utilised by Medical Officers or Specialist Physicians. The sample data supported these hypotheses. The majority of the respondents (94 percent) were medical-orientated personnel, ranging from medical students to highly experienced physicians, who have acquired a specialisation in a certain medical field (see Figure 1).

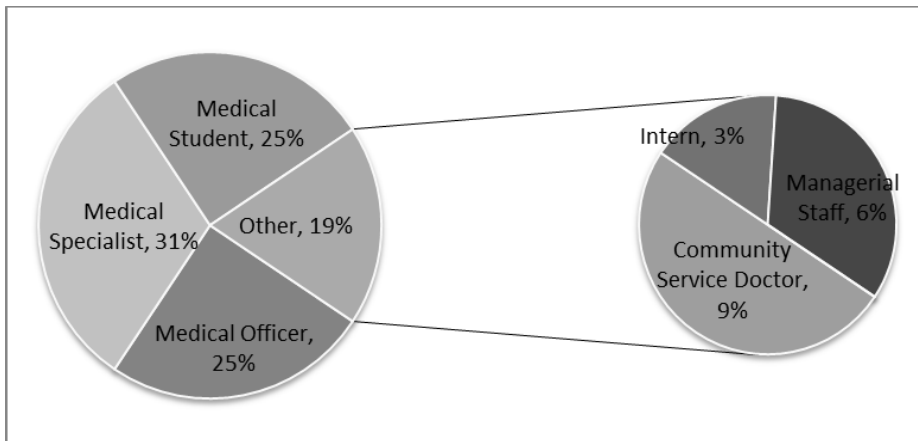


Figure 1. Job title distribution of respondents

According to the demographic data presented, the target population was a fair representation of this province, despite the relatively low response frequency (32 responses).

2. Results

The purpose of the questionnaire was to obtain information pertaining to the use of mobile ICT within the public health care sector of one of the provinces of South Africa. The questionnaire was thus specifically constructed to align with the five domains of a telemedicine service, as previously elaborated on. The results obtained from the questionnaire are therefore represented according to the five domains: Man, Machine, Material, Method and Money. This helps to establish an understanding of the utilisation of mobile devices in health care.

2.1. Man

The questions listed under the Man column in Table 1 were formulated with the aim of obtaining information pertaining to an individual utilising a mobile device to administer clinical medical services. The primary purpose of these questions was to

develop an understanding of the factors which motivate medical staff to utilise mobile devices to facilitate health care services.

The synthesis of the sample data revealed that for 91 percent of the sample (29 respondents) the key motivational factor or incentive to utilising mobile devices in the health care environment is the factor that technology makes the job easier (see Figure 2).

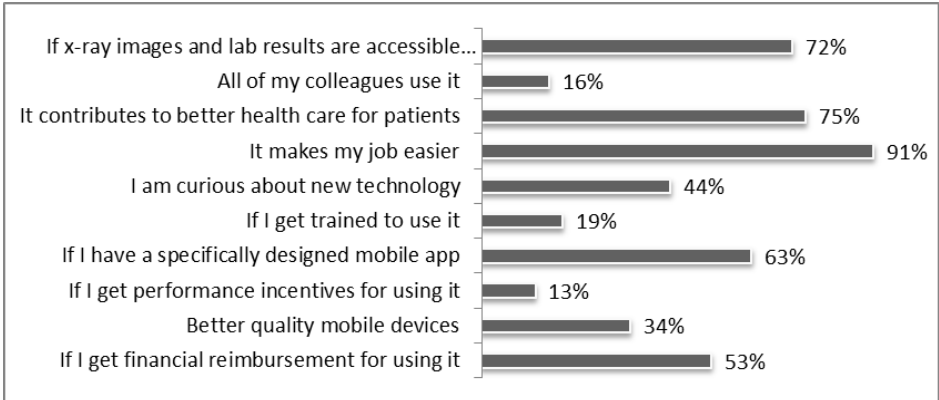


Figure 2. Incentives which promote the use of mobile devices to facilitate telemedicine services

Seventy five percent of the sample was of the opinion that the health care benefits accompanied by the implementation of telemedicine services contribute largely to the preferred use of telemedicine services. Likewise, 72 percent of the respondents highlighted the importance of connectivity and accessibility of medical data with respect to telemedicine services. Finally, 63 percent of the sample is of the opinion that telemedicine-specific health care policies would positively impact the use of mhealth services.

2.2. Machine

In the Western Cape public health care sector the primary devices utilised to perform telemedicine services are mobile phones. The questions aligned with the Machine domain in Table 1 serve to establish a certainty that the statement is indeed valid. An analysis of the sample data pertaining to these questions revealed that 94 percent of the sample population utilise mobile devices within the public health care sector, for the purpose of administering medical care (see Figure 3). Of the sample population, 64 percent use mobile phones.

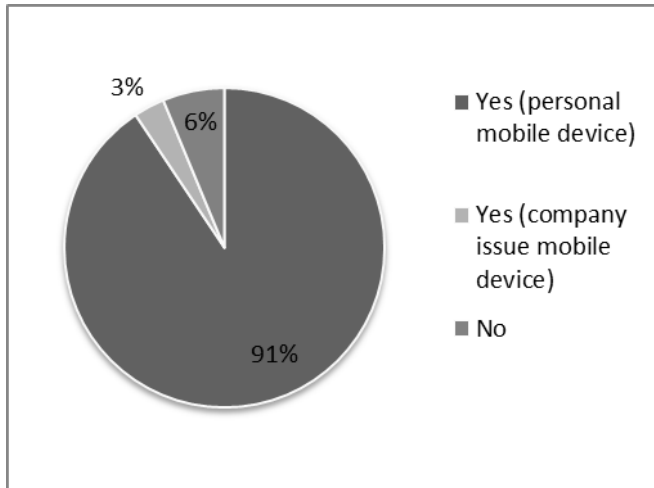


Figure 3. Percentage of sample population utilising mobile devices for health care purposes

72 percent of the respondents use mobile devices to capture, document and transmit medical information. In other words by using a mobile device to capture and transmit patient data, the health care worker is performing a telemedicine service, or more specifically a mhealth service. 28 percent of the sample utilise the digital camera incorporated in modern mobile devices to capture medical data. 41 percent utilise a combination of text based messages and digital cameras to capture such information. Furthermore, the sample data indicates that 41 percent of the health care workers purchased a mobile device with the intention of utilizing the device in the health care environment.

The synthesis of the sample data concluded that the transmission of medical data is conducted by means of mobile devices utilised in the following applications: e-mail, instant messaging (IM), MMS and SMS (see Figure 4). In addition, a resounding 91 percent take advantage of their mobile devices connectivity and mobility to attain medical information via the internet, instead of consulting other sources of information.

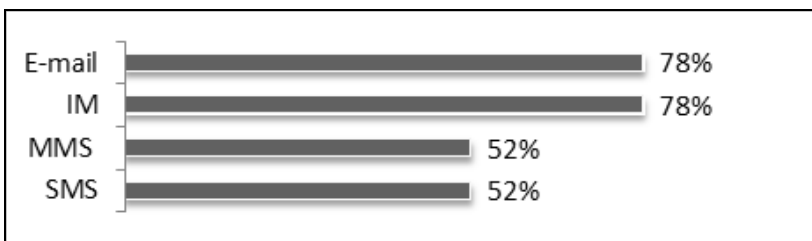


Figure 4. Applications utilised for the transmission of medical data

2.3. Material

The Material domain of a telemedicine service refers to the type of medical information which is captured, transmitted and, according to which a diagnosis is established. As in the case of the four other domains, it too forms an integral part of a telemedicine service. The average material which is captured, analysed and transmitted in conjunction with a telemedicine service, is rated to be acceptable and relatively secure. The questions associated with the Material domain, as listed in Table 1 are aimed at obtaining data which pertains to the material captured and transmitted by means of mobile devices. A number of conclusions were drawn.

As previously mentioned, 72 percent of the respondents utilise a mobile device to capture, document and transmit medical data. The overwhelming majority (96 percent) capture medical material by means of a mobile device camera.

Question 21 prompted the respondents to rate the quality of medical data captured and transmitted via mobile devices. They made their assertions based on a scale ranging from 'Barely distinguishable' (1) to 'Clearly identifiable/high detail' (5). The majority (60.3 percent) considered the medical material captured and transmitted via mobile devices to be more than acceptable (see Figure 5).

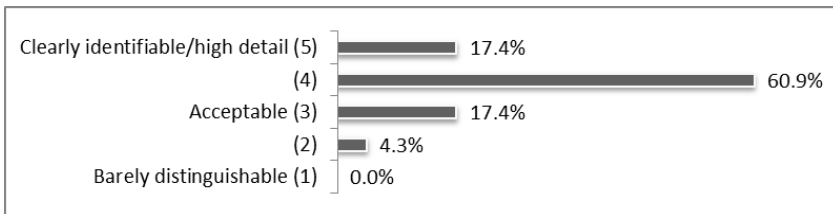


Figure 5. Rating of material quality captured and transmitted by means of mobile devices

Further enquires were made to develop an understanding of the presumed safety of the medical data captured and transmitted. A resounding 69.6 percent (see Figure 6) of the sample rated the capture and transmission of patient medical data via mobile device networks as fairly secure, with only 4.3 percent regarding such services as unsecure.

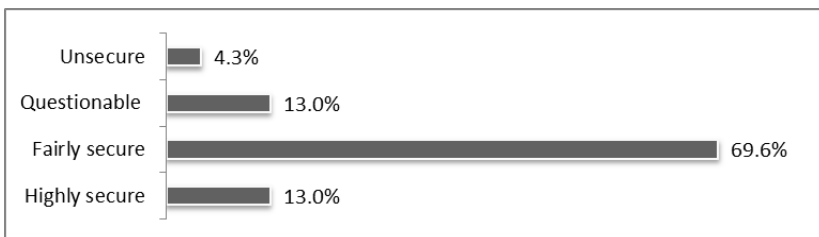


Figure 6. Telemedicine material transmission security rating

2.4. Method and Money

Current health care policies, procedures and ethics are not formulated to incorporate the use of mobile devices to perform telemedicine services. These policies unfortunately provide the basis upon which financial structures are established. [9].

A financial reimbursement structure thus implies that there are policies governing, and methods of measuring the usage of telemedicine services and vice versa. According to the responses, the majority (92 percent) of the respondents do not receive any financial support for utilising mobile devices in order to administer medical care.

Of the health care facilities represented in the sample, only 7 percent are known to be equipped with health care policies which accommodate the use of mobile devices in health care. This information, coupled with the previously mentioned fact that mobile phones are the primary devices utilised for the provision of telemedicine services, indicates that telemedicine services are implemented even in the absence of appropriate health care and mobile device policies.

3. Discussion

The purpose of the questionnaire was to attain an understanding of the use of mobile devices such as mobile phones, laptops and tablets in the health care sector of South Africa, more specifically the Western Cape. The questionnaire participants were considered to be suitably knowledgeable about the South African context and the domain under investigation. They proved to provide a fair representation of the Western Cape health care sector.

The data acquired across the five domains of telemedicine provided ample information pertaining to the more frequent utilization of mobile information and communication technology in the health care sector. Consensus was reached that accessibility, ease-of-use; mobility and connectivity are key factors which promote the use of mobile devices within the health care services.

The majority of the participants utilise mobile phones to capture, transmit and diagnose patient health care data solely because of the added mobility, connectivity, access to information and ease of use. Medical staff executes these services regardless of health care policies or reimbursement structures. The benefit of quality health care outweighs health care policies and financial structures, especially because quality and security of patient data is not impeded.

4. Conclusion

This study has certain limitations of which the relative small sample size is of the greatest concern. It is also possible that persons who responded were biased toward telehealthcare. However, despite these limitations the outcomes of the “Use of Mobile Devices in Health Care” questionnaire provide some pointers for consideration concerning the utilisation of mobile devices in the health care sector of South Africa, for example:

- It was found that the majority (91%) of healthcare workers use their own mobile devices in the execution of their professional tasks. This can contribute

the lack of interoperability of systems and be a drawback for the identification of best practices as the formulation of standard practices to enable telehealthcare.

- The most popular reason for healthcare workers to use their mobile phones is that it makes their job easier and the least popular motivational factor is performance incentives. This is a useful consideration to manage change in which mobile devices are playing a pivotal role.
- A few healthcare workers developed their own healthcare apps. This possible indicate a case for bottom-up innovation initiatives instead of top-down initiatives.

The advantages and the utilisation of mobile devices, in combination with telemedicine or mhealth services, is becoming more evident, despite the lack of appropriate health care policies or financial structures. The results of the questionnaire have opened discussions pertaining to mobile devices in health care. These results must be taken into consideration when plans are made to improve the current health care system of South Africa.

References

- [1] Mars M. Telemedicine in South Africa (2011). In: Wootton R, Patil NG, Scott RE, Ho K, eds. *Telehealth in the Developing World. London, Great Britain: The Royal Society of Medicine Press Limited*; 222–231.
- [2] Telemedicine Task Team (1998). *Establishment of a Telemedicine System for South Africa: Strategic Outline*. 1–8.
- [3] Gulube S, Wynchank S. (2002). The national telemedicine system in South Africa - an overview and progress report. *South African Medical Journal*. 92(7):513–515.
- [4] Etzo S, Collender G. (2010). The mobile phone “revolution” in Africa: Rhetoric or reality? *African Affairs. (Lond)* 109(437):659–668.
- [5] Sood S, Mbarika V, Jugoo S. (2007). What is telemedicine? A collection of 104 peer-reviewed perspectives and theoretical underpinnings. *Telemedicine and e-Health* 13(5):573–590.
- [6] Pillay C. (2013). *South Africa Leads in mHealth*. www.bizcommunity.com. Available at: <http://www.bizcommunity.com/Article/196/574/89398.html>
- [7] Mishra S, Singh I. (2008). mHealth: A developing country perspective. *Make. e-health Connect*. 1–9.
- [8] Gulube S. (2000) Evaluation report of the first phase of the SA National Telemedicine System (NTS). *Pretoria*; 1–22.
- [9] Hartmann A. (2014). *An Assessment of the Telemedicine Services within the Western Cape Public Health Care System*. 1–197.
- [10] Eiselen DR, Uys T. (2005). Questionnaire Design. In: *Analysing Survey Data using SPSS13: A Workbook*. 1–22.
- [11] Van Dyk L (2013). The Development of a Telemedicine Service Maturity Model. *Stellenbosch: Stellenbosch University*. 1–296.