

https://dspace.org/

Potential role of mobile technology in patient self-management in South Africa

Mosehle, Katleho Dominica Miriam

2017
https://hdl.handle.net/10539/23947

Downloaded from a DSpace repository. https://dspace.org/

Potential role of mobile technology in patient self-management in South Africa

Katleho Mosehle

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements of Master of Business Administration.

Johannesburg, 2016

ABSTRACT

The purpose of this research is to establish the likelihood of South Africans' acceptance of mobile health services to monitor and manage their health status. Additionally, this study seeks to determine the potential benefits of mHealth. South Africa has a high incidence of non-communicable diseases which are caused by lifestyle choices. The results of this study may provide stakeholders with tools that would enable patients to become active participants in the ongoing management of their health.

A quantitative research study was utilised to collect data. The sample population consisted of individuals with varying backgrounds and health status. The data was analysed through the use of exploratory factor analysis.

The findings of the analysis show that South Africans are likely to accept and use mHealth. The results from the survey show that the benefits of mobile health services include; increasing accessibility and convenience, better quality healthcare and a potential reduction in the cost of healthcare delivery.

The results of the study were quite positive and indicate that South Africans have a positive behavioural intention to use mHealth services. Mobile health services are beneficial to healthcare consumers as proactive self-care of chronic illnesses is necessary to curb the incidence of non-communicable diseases. mHealth enables health consumers to instantly access healthcare practitioners and relevant health information regardless of their geographic location. This is due to the rich features of smart devices which facilitate two way communication and real-time data transfer.

Future research should explore the effects of mHealth usage on the long-term health outcomes of patients with chronic diseases.

DECLARATION

I declare that this research report is my own, unaided work, except as indicated in the acknowledgements and references. This report is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. This report has not been submitted before for any examination or any degree at this or any other university.

_____

Katleho Mosehle

Signed at _____

On this the_____ day of _____ 2016.

ACKNOWLEDGEMENTS

I would like to express my appreciation to the people who have supported and guided me during my MBA journey.

First and most importantly I would like to thank my parents for their encouragement, love, belief and unwavering support.

I would also like to thank my friends for their continued support and understanding during this two year roller coaster, Prof. Anthony Stacey for his support, encouragement and patience.

Thank you to Dr Yvonne Saini for her supervision.

A special thank you to the friends I made during the MBA. They each contributed to the fun, memorable and worthwhile experience. Thanks to Ayanda, Benedict, Butši, Clive, Mpho, Kholiwe, Taheera, Prevashni and Vusi. The friendships we built will continue beyond this MBA.

TABLE OF CONTENTS

ABSTRACT ..... **II**

DECLARATION ..... **III**

ACKNOWLEDGEMENTS ..... **IV**

LIST OF TABLES ..... ERROR! BOOKMARK NOT DEFINED.

LIST OF FIGURES **6**

CHAPTER 1. INTRODUCTION **7**

1.1 PURPOSE OF THE STUDY 7
1.2 CONTEXT OF THE STUDY 7
1.3 PROBLEM STATEMENT 10
1.3.1 MAIN PROBLEM 11
1.3.2 SUB-PROBLEMS 11
1.4 SIGNIFICANCE OF THE STUDY 12
1.5 DELIMITATIONS OF THE STUDY 13
1.6 DEFINITION OF TERMS 13
1.7 ABBREVIATIONS 15
1.8 ASSUMPTIONS 15

CHAPTER 2. LITERATURE REVIEW **16**

2.1 INTRODUCTION 16
2.2 BACKGROUND DISCUSSION 16
2.2.1 PRIMARY HEALTHCARE 16
2.2.2 NON-COMMUNICABLE DISEASES 17
2.2.3 MOBILE TECHNOLOGY 18
2.2.4 MOBILE HEALTHCARE 18
2.3 SOUTH AFRICAN'S INTENTION AND WILLINGNESS TO USE MOBILE HEALTH TECHNOLOGY 20
2.3.1 PERCEIVED USEFULNESS 21
2.3.2 PERCEIVED EASE OF USE 22
2.3.3 BEHAVIOURAL INTENTION TO USE 23
2.3.4 LIMITATIONS 25
2.4 THE FACTORS INFLUENCING THE ACCEPTANCE AND USE OF MOBILE HEALTH SERVICES 26
2.4.1 USES 26
2.4.2 HEALTHCARE INTERVENTION 28
2.4.3 BENEFITS 29

2.4.4 Removing barriers to healthcare 31
2.5 Conclusion 32
2.5.1 Proposition 1: South Africans are likely to accept and use mobile health services 33
2.5.2 Proposition 2: The potential benefits of mobile health services include: 33

CHAPTER 3. RESEARCH METHODOLOGY 34

3.1 Research methodology / paradigm 34
3.2 Research Design 35
3.2.1 The advantages of using a questionnaire for this study 35
3.2.2 The disadvantages of questionnaires 36
3.3 Population and sample 36
3.3.1 Population 36
3.3.2 Sample and sampling method 37
3.4 The research instrument 37
3.4.1 Advantages of using a questionnaire 39
3.4.2 Disadvantages of using a questionnaire 40
3.5 Procedure for data collection 40
3.6 Data analysis and interpretation 40
3.7 Limitations of the study 41
3.8 Validity and reliability 41
3.8.1 External validity 41
3.8.2 Internal validity 42
3.8.3 Reliability 42
3.9 Demographic profile of respondents 42
3.9.1 Age profile 42
3.9.2 Gender profile 43

CHAPTER 4. PRESENTATION OF RESULTS 45

4.1 Introduction 45
4.2 Health status and Mobile device ownership 45
4.2.1 Profile of current chronic patients 45
4.2.2 Profile of family history in respect of chronic diseases 46
4.2.3 Ownership of a smart device 46
4.3 Descriptive statistics and distributions 47
4.3.1 Hypothesis testing 48
4.3.2 Mean and standard deviation 49
4.3.3 Factor analysis results 53
4.3.4 Regression analysis 57
4.3.5 Scale Distributions 59
4.4 Results relating to the likelihood to accept and use mobile health services 60
4.5 Results relating to the potential benefits of mobile health services 60
4.6 Summary of results 60

CHAPTER 5. DISCUSSION OF RESULTS 62

5.1 INTRODUCTION 62
5.2 HEALTH STATUS AND MOBILE DEVICE OWNERSHIP 62
5.2.1 PROFILE OF CURRENT CHRONIC PATIENTS 62
5.2.2 PROFILE OF FAMILY HISTORY IN RESPECT OF CHRONIC DISEASES 63
5.2.3 OWNERSHIP OF A SMART DEVICE 63
5.3 DETAILED DISCUSSION AND REVIEW OF DESCRIPTIVE STATISTICS 63
5.3.1 HYPOTHESIS TESTING 64
5.3.2 MEAN AND STANDARD DEVIATION 64
5.3.3 FACTOR ANALYSIS 65
5.3.4 REGRESSION ANALYSIS 65
5.4 DISCUSSION ON LIKELIHOOD TO ACCEPT AND USE MOBILE HEALTH SERVICES 67
5.5 DISCUSSION ON THE POTENTIAL BENEFITS OF MOBILE HEALTH SERVICES 67
5.5.1 CONVENIENCE AND ACCESSIBILITY 68
5.5.2 COST REDUCTION 68
5.5.3 QUALITY 69
5.6 CONCLUSION 69

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS 70

6.1 INTRODUCTION 70
6.2 CONCLUSIONS OF THE STUDY 71
6.2.1 SOUTH AFRICANS LIKELIHOOD TO ACCEPT AND USE MOBILE HEALTH SERVICES 71
6.2.2 THE POTENTIAL BENEFITS OF MOBILE HEALTH SERVICES 71
6.3 RECOMMENDATIONS 71
6.3.1 HEALTHCARE POLICYMAKERS 72
6.3.2 HEALTHCARE FUNDERS 73
6.3.3 RESEARCHERS 74
6.4 CONCLUSION 74

REFERENCES 76

APPENDIX A: RESEARCH INSTRUMENT 80

APPENDIX A1: LETTER TO SURVEY RESPONDENTS 80
APPENDIX A2: RESEARCH INSTRUMENT 81

APPENDIX B: DESCRIPTIVE STATISTICS 86

APPENDIX B1: HYPOTHESIS TESTING 86
APPENDIX B2: MEAN AND STANDARD DEVIATION 87

APPENDIX C: FACTOR ANALYSIS..... 89

APPENDIX D: REGRESSION ANALYSIS..... 91

APPENDIX E: GAUSSIAN DISTRIBUTION FIT 92

APPENDIX E1: GAUSSIAN DISTRIBUTION FIT 92
APPENDIX E2: GAUSSIAN DISTRIBUTION FIT (2) 94

LIST OF TABLES

Table 1: Abbreviations and their definitions 15

Table 2: Structure of the questionnaire 39

Table 3: T-test confidence 48

Table 4: T-test p-values 49

Table 5: Equality of variances 49

Table 6: Mean and standard deviation 51

Table 7: Factor Analysis 55

Table 8: Renamed factors 56

Table 9: Analysis of variance (ANOVA) 57

Table 10: Fit statistics for R-square 57

Table 11: Table of parameter estimates 58

LIST OF FIGURES

Figure 1: A representation of the technology acceptance model (Davis et al., 1989) 21

Figure 2: An illustration of the acceptance and use model proposed by Sarker and Wells (2003) 24

Figure 3: An overview of the use of mobile devices by heatlhcare practitioners (PricewaterhouseCoopers Health Research Institute, 2014)..... 28

Figure 4: Continuum of mHealth Tools (Kumar et al., 2013) 29

Figure 5: Age profile of respondents 43

Figure 6: Gender profile of respondents..... 43

Figure 7: Chronic disease profile of respondents 45

Figure 8: Profile of family history of respondents..... 46

Figure 9: Profile of respondents who own a smart device 47

Figure 10: Plot of Eigenvalues..... 53

Figure 11: Distribution for Intention to use mHealth 59

CHAPTER 1. INTRODUCTION

1.1 Purpose of the study

The objective of this study is to explore the role that mobile health technology can play in improving the health outcomes of chronic patients in South Africa. This study focuses on the adoption and use of mobile health (mHealth) in patient self-monitoring. The results of this study can be used in primary healthcare for disease prevention, health education, improving the quality of healthcare provision and the promotion of equitable access to healthcare.

1.2 Context of the study

South Africa has a high prevalence of non-communicable diseases and this is expected to rise in the near future, especially in poor communities (Mayosi et al., 2009). Due to income inequality and under resourced public health facilities, there is inequitable access and delivery of health services in South Africa (Harris et al., 2011).

Non-communicable diseases (NCDs) also referred to as chronic conditions, encompass cardiovascular diseases (CVD) including hypertension and hyperlipidaemia, cancers, diabetes and chronic respiratory disease (Beaglehole et al., 2011; Mayosi et al., 2009). This study will be limited to mobile health services (MHS) in respect of NCDs which can be prevented or managed once diagnosed such as diabetes or hypertension. The study also aims to determine how access to and provision of health services can be enhanced.

Non-communicable diseases cannot be passed from one person to another (Mayosi et al., 2009), although family history may be an indicator that an individual is at risk of developing a chronic illness. The predominant causes of non-communicable diseases are tobacco use, a poor diet and low physical activity (Kahn, Yang, & Kahn, 2010; Phaswana-Mafuya, Peltzer, Chirinda, Musekiwa, & Kose, 2013). This is an indication that NCDs are preventable and that the onset of

NCDs can be prolonged. When an individual is diagnosed with a chronic illness, the specific disease can be managed to curb its severity through a concerted effort to change unhealthy behaviours. In their research into the sociodemographic predictors of NCDs, Phaswana-Mafuya et al. (2013) found that the average South African over 50 years of age had 3 of the 4 main risk factors associated with NCDs. Free et al. (2013a) are of the opinion that individuals who adopt healthy lifestyles can prevent or prolong the onset of NCDs.

Over 22 million people die of NCDs each year worldwide (Free et al., 2013a). Statistics South Africa reported that in 2013, 27% of South Africans had died as a result of NCDs (Statistics South Africa, 2014b).

Day, Groenewald, Laubscher, van Schaik, and Bradshaw (2014) reviewed statistics available from Statistics South Africa (Stats SA) and four household surveys to determine the prevalence of hypertension among South Africans. Hypertension, also known as high blood pressure, is directly linked to cardiovascular diseases and diabetes. The results of the study showed that only 35.7% of hypertensive patients were on active treatment (Day et al., 2014). This alarming statistic indicates a lack of disease management on the part of the healthcare provider and the patient.

A tailored approach is required to educate people at-risk of being diagnosed with NCDs, including ongoing education and support for existing chronic patients. Healthcare providers serve an important function in educating and promoting healthier living and the self-management of chronic diseases (Free et al., 2013a). High risk individuals and chronic disease sufferers need to be treated as partners and provided with the necessary tools to empower themselves. Mobile devices would enable this kind of information sharing through education and awareness initiatives to enable the ongoing monitoring and management of chronic diseases (West, 2012).

With the ubiquity of mobile phone use and its wide appeal, the focus has changed from eHealth to mHealth. eHealth was firmly focused on computer based health information systems for providers and patients' access to health related information (Mechael, 2009). mHealth is the utilisation of mobile technology in the delivery of

healthcare services (Kahn et al., 2010). Mobile health technology includes health related information systems and software, built-in health applications (apps), apps available for general download, custom-built apps for specific organisations as well as activity trackers that come standard with sensors to monitor and record health data. mHealth enhances communication between heatlhcare providers and patients, and with the increasing rate of chronic diseases, mHealth offers alternate care strategies for diagnosis and treatment (Kahn et al., 2010).

Smartphones and other smart devices have made information more accessible and have changed the way in which people communicate with each other. Smartphones and smart devices such as tablets have had a significant impact on people's lives, especially in the business, education and health sectors (Sarwar & Soomro, 2013). Due to their portability, smart devices are always within reach of the owner, making them essential to an individual's daily life (Free et al., 2013b; Sarker & Wells, 2003).

Mobile technology has become ubiquitous and can become a vital component of healthcare provision and remote monitoring (Kahn et al., 2010), especially at regional and district level. Mobile health interventions could have beneficial effects on healthcare delivery (Free et al., 2013a).

mHealth may be the key to revolutionising healthcare by extending and enhancing the reach of primary healthcare beyond the setting of a clinic or healthcare practitioners' consulting rooms. Meier, Fitzgerald, and Smith (2013) state that mHealth could be responsible for demystifying the science of medicine.

mHealth is already being used to remind patients to take their medication at pre-set times and could be optimised to extend healthcare services to underserved communities (West, 2012).

The use of mHealth is on the rise, particularly within the public health sector in developing nations (Davey & Davey, 2014). The biggest draw card to mHealth is that mobile technology has the capability to solve the greatest barrier to global health efforts – access to care (Tomlinson, Rotheram-Borus, Swartz, & Tsai, 2013). In developing countries, accessing primary healthcare is a challenge because of

structural problems, poor infrastructure, the distance between villages and clinics, and inadequate transportation to and from remote areas.

The emergence of new mobile health services and solutions is a sign of a paradigm shift in healthcare service delivery. Mobile health services could potentially transform healthcare models from one of passive patients to a more inclusive model where the patient is treated as a partner to his/her healthcare practitioner (Meier et al., 2013).

Boulos, Wheeler, Tavares, and Jones (2011) believe that there is great potential for mobile technology to transform healthcare and clinical interventions. The adoption of mHealth need not be expensive, research has shown that in some developing countries people may have access to smartphones whilst not having access to water (Lewis, Synowiec, Lagomarsino, & Schweitzer, 2012). Developing countries face other challenges besides the ever increasing risk of NCDs. Often these countries have budgetary constraints and as a result cannot provide equitable healthcare. Another challenge is the scarcity of medical resources. Currently there is no conclusive empirical study on the effectiveness of mHealth in the improvement of health outcomes; however, there is a growing body of research in this field especially with regard to low and middle income countries.

1.3 Problem statement

This study intends to demonstrate how South Africans could benefit from the adoption of mobile health services. The current health system challenges include inequitable access to care, the increasing prevalence of NCDs, negative perceptions of quality in the public sector, high costs of care in the private sector and the lack of or inability to access health related information (Harris et al., 2011).

This study is being undertaken to assess the probability of transforming the mind-set of chronic patients from being passive in the management of their chronic illness to being active participants in the monitoring, treatment and ongoing management of their chronic illness.

South Africa has a high incidence of NCDs and a large number of citizens who are at-risk of being diagnosed with NCDs, therefore these concerns need to be addressed urgently (Mayosi et al., 2009). The public health system will not be able to cope with increasing patient numbers without implementing innovative solutions. The focus on the public sector is attributable to the fact that most South Africans make use of public health services (Statistics South Africa, 2015).

It is in the best interests of healthcare funders and practitioners to enable patient self-management. The study will show that mHealth is a convenient medium and enables access to care as it is not dependent on the individual's location, education or income. The high cell phone penetration rate in South Africa provides a great platform for the implementation of a successful mHealth strategy.

1.3.1 *Main problem*

This study is being conducted in order to understand the factors that might influence people's willingness to adopt and use of mobile devices to manage or maintain their health status.

Technology has transformed various industries (Kahn et al., 2010; Klasnja & Pratt, 2012). Smart devices have significantly shaped the business, education and health sectors (Sarwar & Soomro, 2013). Current mobile technology innovation may play a role in improving the delivery of health services and health outcomes (Klasnja & Pratt, 2012). There is little evidence to support the acceptance of mobile health technology among healthcare consumers and this concept needs to be assessed (Sun, Wang, Guo, & Peng, 2013). Holden and Karsh (2010) reviewed the acceptance of the Technology Acceptance Model in healthcare, however their study reviewed data pertaining to the use of technology by health practitioners and excluded patients.

1.3.2 *Sub-problems*

Sub-problem 1: To analyse South Africans' intention and willingness to use mobile health

Sub-problem 2: To identify the factors influencing the acceptance and use of mobile health services

1.4 Significance of the study

The South African healthcare system is under immense strain due to the cost of healthcare provision, the burden of communicable and non-communicable diseases and the shortage of medical professionals. Citizens in remote areas do not have equitable access to health services (Harris et al., 2011), this can result in unnecessary deaths or hospital admissions for illnesses that could have been prevented or treated earlier.

A different strategy needs to be applied, a strategy that brings care closer to the patient. A successful healthcare policy should encourage ongoing monitoring of chronic conditions as well as equip healthcare providers to make better decisions regarding the care of their patients. Leading researchers agree that mobile technology can remove barriers to care, such as access and several studies have shown an improvement in the quality of care provided through the application of mHealth strategies (Klasnja & Pratt, 2012; Krishna, Boren, & Balas, 2009).

This study might provide guidance to the efficacy of the adoption and utilisation of mHealth in a primary healthcare setting. The study will also assess the role and responsibility of patients in the ongoing monitoring and management of their health status.

Currently the management of a chronic disease is placed solely on the healthcare practitioner, the patient should start playing an active role in monitoring and managing their personal wellbeing and health (Blake, 2008; PricewaterhouseCoopers Health Research Institute, 2014).

Källander et al. (2013) suggest that mHealth could be used in the delivery of enhanced healthcare services to individuals and to strengthen healthcare systems.

Stakeholders who may benefit from this study are healthcare practitioners, medical aid funds, health insurance administrators, policymakers, people at high risk of being diagnosed with a NCD and chronic disease patients.

1.5 Delimitations of the study

The study will include broad day-to-day healthcare provision in the public and private sectors in South Africa, however, cancers and in-hospital treatments will be excluded. The recommendations stemming from this study may be applicable to other developing nations although the focus is specifically for the South African healthcare industry.

This study will not assess the broad impact of information technology. This study will not review costs related to the implementation of mobile health solutions.

The purposes of the study preclude the adoption or use of mHealth on the basis of geographical area or income.

1.6 Definition of terms

Access is the access to health services; it includes the opportunity to use health services and encompasses the choice of health service and healthcare provider (Harris et al., 2011)

At-risk or high risk individuals refers to persons who are likely to be diagnosed with a non-communicable disease due to family history or lifestyle habits

Care plan, treatment plan or treatment protocols refer to the detailed disease management steps that need to be followed in providing treatment and support to a patient with a chronic disease

Chronic disease or chronic illness, is a life long illness that is incurable; it is controlled through the use of medication or other medical treatment

Diagnosis is the process by a healthcare practitioner to determine the nature of a disease that the patient is suffering from

Electronic health record, also referred to as an Electronic Medical Record is a digitised record of a patient's medical history

Healthcare consumer is an actual patient or potential recipient of health services

Healthcare funders is a term that refers collectively to medical aid schemes, medical aid administrators, health insurers as well as organisations that regulate the business of medical schemes, administrators and insurers such as the Board of Healthcare Funders and the Council of Medical Aid Schemes

Healthcare practitioner or healthcare providers are used in reference to all providers of healthcare services, from general practitioners, specialists, nurses to various auxiliary health service practitioners (e.g. physical therapists and paramedics)

Mobile devices include portable computers, such as laptops, smartphones and tablets (Boulos et al., 2011)

Mobile health (mHealth) and mobile health services (MHS) refer to the provision of healthcare services and information sharing or health data gathering through portable devices such as smartphones, tablets and laptops (Kahn et al., 2010; Källander et al., 2013)

Non-communicable diseases (NCD) are illnesses which are non-infectious and cannot be transferred from one person to another (Mayosi et al., 2009)

Primary healthcare is often the first level of healthcare provision; primary healthcare includes preventative treatment and promotion of health through education

1.7 Abbreviations

Table 1: Abbreviations and their definitions

Abbreviation	Definition
CVD	Cardiovascular diseases
eHealth	Electronic health
EHR	Electronic health record
EMR	Electronic medical record
mHealth	Mobile health
MHS	Mobile health services
NCD	Non-communicable diseases
SD	Standard deviation

1.8 Assumptions

The assumptions made with regard to this study:

- It is assumed that equitable and affordable access has a single definition in the private and public health sectors
- It is assumed that patients and practitioners are familiar with mobile devices such as smartphones and tables as well their general use
- Health consumers are aware of the general use of mobile technology
- Patients and practitioners have access to 3G, 4G/LTE and/or Wi-Fi connections in order to access and transact on their mobile devices

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This section provides an overview of the applicable literature with regard to the problem and the sub-problems stated in Chapter 1. The following themes will be explored; factors which influence the adoption of technology, acceptance of mobile technology in healthcare and the effect of mobile health on disease management. In the context of this paper, healthcare refers to primary health services and not tertiary healthcare where a patient may require intensive care or surgery. Furthermore, mHealth refers to health initiatives delivered and accessed through mobile devices including smart devices and wearable fitness or activity trackers.

The terms healthcare practitioner, healthcare provider and provider will be used interchangeably to refer to practicing health professionals such as nurses, doctors or specialists. Healthcare and care will also be used interchangeably in reference to healthcare services.

mHealth and mobile health services will be used synonymously in reference to healthcare services provided through mobile technology.

2.2 Background discussion

2.2.1 *Primary healthcare*

Primary healthcare refers to the first point of contact when seeking care. The institutions which are regarded as primary care providers include public and private clinics, pharmacies and general family practitioners. According to the 2014 General Household Survey, 69,3% of South African households stated that in case of illness, they would first seek care at a public clinic or hospital (Statistics South Africa, 2015). This statistic demonstrates that the majority of South Africans are reliant on the public health sector.

The results of the 2014 General Household Survey further illustrate some of the challenges faced by healthcare consumers; long waiting times to access care and medication shortages at health facilities (Statistics South Africa, 2015).

It is clear that many South Africans still face challenges when attempting to access care. In addition, the public healthcare system is resource-deficient as it also struggles with the scarcity of skilled medical professionals and numerous health service shortages which affect mostly poor people who rely on the public sector for health services (Coovadia, Jewkes, Barron, Sanders, & McIntyre, 2009; Harris et al., 2011)**.**

2.2.2 *Non-communicable diseases*

In their mortality report, Statistics South Africa (2014b) confirm that collectively NCDs account for 27% of deaths among South Africans.

Non-communicable diseases are a burden on the healthcare system and thousands of South Africans are dying each year of preventable illnesses (Mayosi et al., 2009). The common risk factors of non-communicable diseases are tobacco use, a high fat and/or a high sugar diet, alcohol consumption and low physical activity (Beaglehole et al., 2011; Kahn et al., 2010). By altering their lifestyles, at-risk individuals can prevent the onset of NCDs and chronic patients can manage their condition better. Patients can use their smartphones to track and maintain their physical activity levels (Klasnja & Pratt, 2012). A large number of smartphones have built-in sensors that allow users to monitor their physical activity. Native smartphone applications (apps) can also be downloaded and used to record, store and track health data such as heart rate, blood pressure and blood glucose levels.

In a review of available South African survey data, Day et al. (2014) found that only 35.7% of hypertensive patients were on active treatment. This is a clear indicator of poor disease management on the part of the healthcare provider and the patient.

The severity of a chronic illness such as CVDs or diabetes can be managed and reduced through the patient's adherence to a strict treatment plan, exercise and

ongoing self-care. For example, a diabetic patient can monitor his/her blood glucose levels at home through the use of a glucometer or mobile device with the necessary capabilities. Kumar et al. (2013) are of the view that mHealth techniques may be useful in real-time patient monitoring and in identifying the factors that influence patients' adherence to treatment.

2.2.3 *Mobile technology*

Mobile technology includes cell phones, smartphones, handheld and portable computers (e.g. ultra-books) and tablet computers (Free et al., 2013b). Mobile phones have been in use for a number of years now, however smartphones and other smart devices are recent technological innovations. Smartphones have advanced computing capabilities such as instant messaging, internet access, geo-positioning systems and incorporate features that were previously only available on personal computers (Boulos et al., 2011; Sarwar & Soomro, 2013).

In June 2015 South Africa had an estimated 38 million unique mobile phone owners (Groupe Speciale Mobile Association, 2015). The World Bank's 2015 report on Information and Communication Technology states that South Africa has 149.7 mobile phone subscriptions for every 100 people (World Bank, 2016). Such a high penetration rate leads to the assumption that mobile technology has been widely accepted in society, this may be partly due to mobile phones becoming more sophisticated and affordable (Mechael, 2009).

The use of mobile technology, including mHealth requires users to have access to internet connectivity through 3G, LTE, Wi-Fi or an ADSL line. The commonly used functionalities of mobile devices include voice, text messaging, mobile apps, multimedia and two-way information sharing.

2.2.4 *Mobile healthcare*

The evolution of smartphone technology has transformed various industries worldwide, including healthcare (Kahn et al., 2010; Sarwar & Soomro, 2013). The high penetration rate of smartphones and increasing popularity of smart devices

can be leveraged for greater mHealth utilisation. mHealth refers not only to the use of smartphones, rather to all smart devices which have internet connectivity.

The widespread utilisation of mobile technology leads to the presumption that mobile technology could have a significant role to play in the day-to-day lives of South Africans. mHealth could potentially change the health behaviour and self-care of chronic patients and high risk individuals.

Currently South Africa has a small number of mHealth services; these are mostly text messaging services for TB and HIV/AIDS patients to remind them to take their medication. Examples of these text messaging services include Project Masiluleke and SimPill (Akter & Ray, 2010; Green, 2005). These projects also encourage knowledge sharing among patients and care providers.

The scope of mobile health services is broader than just text message services to remind patients to take their medication. Mobile health services (MHS) which include remote health consultation and location-based services delivered through mobile communication channels, could be used to monitor patients' adherence to a pre-determined treatment plan (Istepanian, Laxminarayan, & Pattichis, 2006). MHS could also be used to proactively track the vital health signals of patients. Health data which can be recorded, stored and monitored on mobile devices include blood pressure, cholesterol and blood glucose levels. Mobile health services include the following broad categories of services;

- Health education and information
- Diagnostic and treatment support
- Remote and self-monitoring of chronic illness
- Medication compliance, medication and consultation reminders
- Health status tracking and monitoring

mHealth has a far greater scope in that native mobile applications (apps) can be used to store patient health data, track patient adherence to treatment and enable better communication between patients and healthcare practitioners, all in real-time. The adoption of mHealth in disease management could signal a turning point where

the patient and healthcare provider become partners in managing a chronic condition. mHealth could also assist in overcoming a number of barriers to quality healthcare (Tomlinson et al., 2013), especially in rural and peri-urban areas. Mobile health technology would enable chronic patients and high risk individuals to be more accountable for their health and wellness irrespective of geographic location or time. Users of mHealth would benefit from the convenience and accessibility afforded by the services available.

2.3 South African's intention and willingness to use mobile health technology

Boulos et al. (2011) regard smartphones as the success story of technological innovations in recent history, in a short period of time they have penetrated society, capturing users from teenagers to senior citizens. Wu, Wang, and Lin (2007) affirm that mobile technology can become an enabler of healthcare delivery.

The best predictor of technology acceptance is the technology acceptance model. The technology acceptance model (TAM) is a well-known tool which is used to predict users' acceptance and use of new technology, it was first described by Davis, Bagozzi, and Warshaw (1989). The TAM is the most applicable technology acceptance model as it is applied to a broad spectrum, of information technologies and user populations (Mathieson, 1991).

The main objective of TAM is to present an explanation of the determinants for the broad acceptance of information technology and the end user's intention to use the information system or service (Davis et al., 1989). These determinants are the system's usability which is the perceived ease of use and the perceived usefulness. These attributes sum up the user's perception and attitude towards new technology.

Figure 1 demonstrates the dependant variables in a consumer's decision to make use of a particular technological device or service.

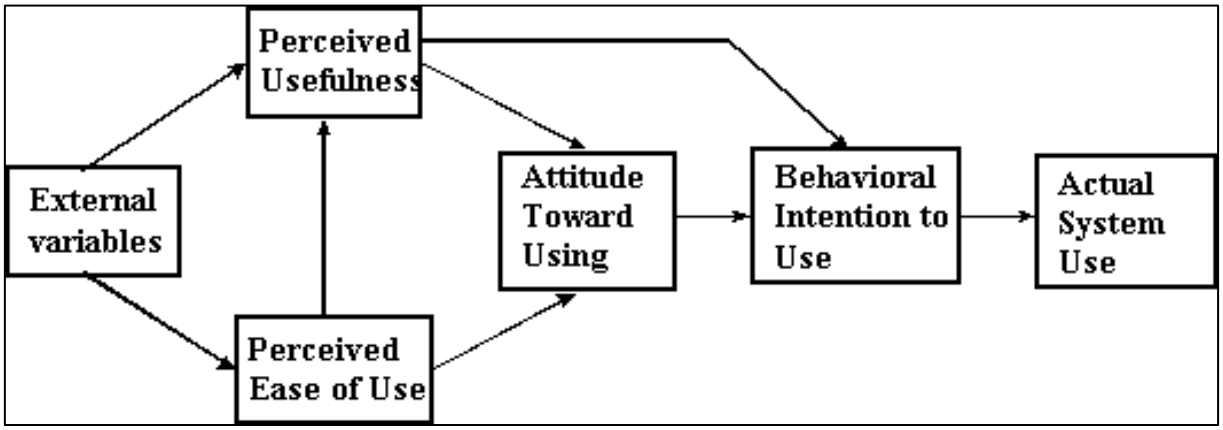


Figure 1: A representation of the technology acceptance model (Davis et al., 1989)

The TAM is a theory that looks at planned behaviour. TAM is relevant to this study as we attempt to determine whether patients with chronic illness intend to use mHealth to manage their health conditions, and the factors that would influence their willingness to adopt and use mHealth. The essential components of TAM are the perceived usefulness and perceived ease of use, which determine the behavioural intent to use the specific technology. These components will be explored briefly below.

2.3.1 *Perceived usefulness*

mHealth is useful as it provides a two-way communication platform for patients and health practitioners (Cole-Lewis & Kershaw, 2010). Mobile health services provide patients and high risk individuals with a range of possibilities to engage meaningfully with their healthcare practitioners as well as to continuously monitor and manage their chronic illnesses.

Mobile health services have the added benefit of convenience. The end users would benefit from the reduction of time spent travelling to and from medical appointments. Time spent travelling and the costs of travel are acknowledged as access barriers to healthcare services (Harris et al., 2011). Another benefit of MHS is the accessibility of health information and education tools. The patient does not have to physically consult with a healthcare practitioner to learn more about a

specific disease as there are applications and tools that could provide them with the necessary information at any given time. An example of this is *WebMD,* which is a mobile app, and website that can be accessed for free and provides educational health information in plain language to health consumers.

2.3.2 *Perceived ease of use*

Acceptance of mHealth among providers is driven by capability, perceived ease of use, usefulness or practicality and features (Sarker & Wells, 2003; Wu et al., 2007). There are few studies on the perceptions or use of MHS from the patient's point of view, the majority of research conducted thus far has focused on the acceptance and adoption of mHealth by healthcare practitioners (Sun et al., 2013).

In their study, Kim and Chang (2007), found that the perceived usefulness of mHealth had a significant impact on the users' behavioural intention. The unparalleled acceptance of mobile technology leads to the assumption that mobile services are relatively easy to use. People have very personal relationships with their phones and they are always in a bag nearby, in their hands or pockets (Klasnja & Pratt, 2012).

Mobile devices have become so easy to use that manufacturers no longer include user manuals in the packaging. Due to their portability and vast popularity, people carry their mobile devices at all times (Sarker & Wells, 2003). The compact build of smartphones is convenient and enables accessibility on the go.

Boulos et al. (2011) suggest that the natural evolution of healthcare is through mobile technology because it is information sensitive and convenient. Free et al. (2013a) recognise that traditional means of communication such as information leaflets have limitations while mHealth provides a means to deliver individual level support and encouragement to heatlhcare consumers.

2.3.3 *Behavioural intention to use*

This research aims to determine whether the potential benefits of MHS would influence the likelihood of using mHealth. Wu et al. (2007) supplement existing research by stating that users' adoption and acceptance can be better predicted by the user's behavioural intentions.

Existing mHealth innovations could address an array of health issues such as making healthcare more accessible, medication adherence, remote consultation, diagnosis and data collection as well as enabling better patient-provider communication (Cole-Lewis & Kershaw, 2010).

MHS tools are suited to changing the behaviour of patients and those at-risk because mHealth allows for real-time patient-tailored health communication and solutions that can be accessed anywhere.

The results of this study seek to demonstrate that the majority of chronic patients and high risk individuals would have a positive behavioural intention to use mHealth to track, monitor and manage their health and overall wellbeing. Mobile technology has become pervasive, is inexpensive and requires no technological expertise for utilisation (Cole-Lewis & Kershaw, 2010; Rice & Katz, 2003). The conclusion that can be drawn from this is that mobile technology would be readily accepted and used.

Although widely used, the TAM was not developed specifically for use within healthcare systems and would benefit from modifications (Holden & Karsh, 2010). This suggestion is fitting as TAM was developed before the birth of mobile devices. Holden and Karsh (2010) reviewed the technology acceptance model and its relevance to healthcare in light of growing interest in eHealth and mHealth and found that TAM forecasts significant usage and acceptance in health technology.

There is adequate empirical evidence that TAM is the best tool for predicting technology adoption (Holden & Karsh, 2010; Wilson & Lankton, 2004).

Sarker and Wells (2003) proposed that the acceptance of mobile devices was dependant on the user interface and network capabilities, in other words the features of the devices. The other aspects indicated by Sarker and Wells (2003) are well illustrated by figure 2.

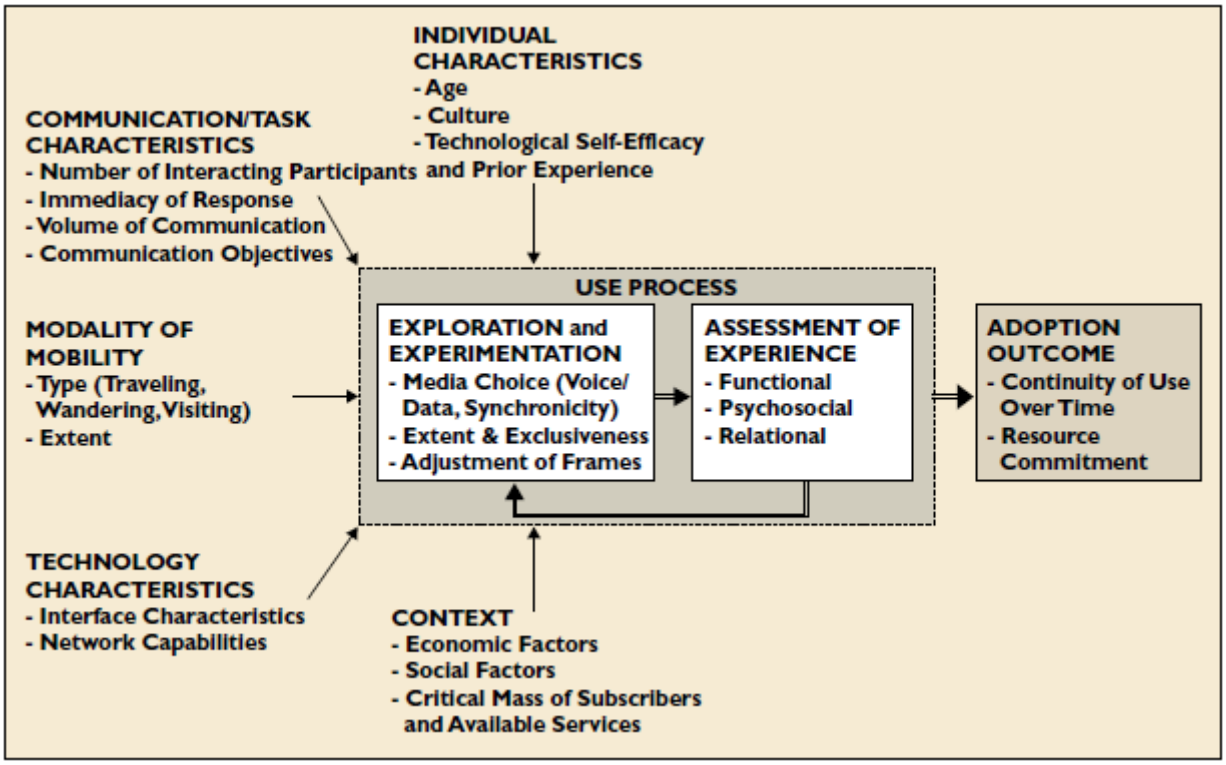


Figure 2: An illustration of the acceptance and use model proposed by Sarker and Wells (2003)

This model has been used by several researchers in e-commerce and m-commerce; although its application in mHealth has not been widely documented. The most notable observation by Sarker and Wells (2003) is that improved web functionality in mobile phones would drive the need and use of data and in turn increase the rate of adoption. This was a significant prediction and the universality of web-based content on mobile devices validates Sarker and Wells' forecast that this functionality would be essential to the adoption of mobile devices. This particular model is relevant to mHealth as it focuses on the features that users look for in technology.

Features

Technological innovations have enhanced user preferences and the features of smart devices have become key attractions. Mobile phones are becoming more sophisticated, affordable and easy to use (Mechael, 2009).

Mechael (2009) contends that the most notable feature of a smartphone is the capability to enable communication and transfer of information among literate and illiterate communities. Klasnja and Pratt (2012) suggest that the sophisticated camera and video specifications of smartphones make them an affordable tele-monitoring device.

Mobile devices have extensive capabilities and advanced processing power which enables them to perform high level functions such as access the internet, geo-location, play and share multimedia content and real-time communications (Boulos et al., 2011; Sarwar & Soomro, 2013). Today's smart devices have mass appeal across age groups and income levels.

mHealth interventions do not have to rely on one functionality, e.g. text messaging (Klasnja & Pratt, 2012). The technical and processing capabilities of today's smartphones support third party apps, sensory functionality and wireless connectivity which increase their appeal and scope of possible use in healthcare.

2.3.4 *Limitations*

The perceived limitations for mHealth adoption include the high data costs (especially in developing countries), confidentiality and security, reliability of telecommunication networks and the poor quality of public health systems (Mechael, 2009).

Boulos et al. (2011) noted that another limitation of mobile devices was the storage capacity; this is not an accurate statement as a large number of smart devices have expandable memory and others have large internal storage capabilities.

Successful adoption of mHealth requires stakeholders in the healthcare and technology sectors to critically evaluate the potential benefits, barriers to and limitations of mHealth.

2.4 The factors influencing the acceptance and use of mobile health services

Mobile devices have become popular in every aspect of consumers' lives. Technology and healthcare have also become more interconnected. mHealth is still evolving; its use and popularity is driven by digitised health records, increased interest in preventative care and the need to curb the escalating costs of healthcare.

With the ubiquity of mobile phone use and its wide appeal, the focus has changed from eHealth to mHealth. eHealth refers to computer based health information systems for providers and patients to access health related information (Mechael, 2009).

2.4.1 *Uses*

Many mobile phone users make use of mHealth, although very informally (Mechael, 2009). An example is a smartphone user who uses the built-in pedometer to count the number of steps they take daily.

The uses for mHealth range from improving physical activity, scheduling doctor's appointments to monitoring the progression of a chronic disease (Mechael, 2009).

Text message appointment reminders were the beginning of formalised mHealth initiatives. Globally, mHealth is promoting the use of integrated health databases in the form of electronic health records, EHRs (Mechael, 2009). An EHR is an electronic repository used to store a patient's health information (Silva, Rodrigues, de la Torre Díez, López-Coronado, & Saleem, 2015). A number of South African medical aid schemes have begun implementing and utilising EHRs. Silva et al. (2015) state that health consumers have increasingly begun requesting access to

their health information, and this is largely due to the emergence and accessibility of mHealth solutions.

Fjeldsoe, Marshall, and Miller (2009) reviewed studies which evaluated the use of SMS interactions and related changes in health behaviour. Of the 14 studies reviewed, 10 focused on clinical care such as self-management of diabetes (Fjeldsoe et al., 2009). Fjeldsoe et al. (2009) confirm that positive behaviour changes were observed in 13 of the 14 studies, leading to the conclusion that there is preliminary evidence of positive health outcomes of mHealth in a clinical setting.

Free et al. (2013b) reviewed published studies that examined the benefits of mHealth and found that there was moderate impact on health outcomes due to the use of mHealth support interventions, diagnosis and ongoing disease management. Through its interactive features, mHealth can serve the additional purpose of enabling health providers to understand the influencers of certain health behaviours in patients (Klasnja & Pratt, 2012).

Patients are increasingly accessing health related information through their smartphones (Boulos et al., 2011). The PricewaterhouseCoopers Health Research Institute (2014) surveyed 1,000 doctors and nurses and their results show that more medical personnel are making use of mobile devices in healthcare interventions. Figure 3 is a comparison of the health activities undertaken by providers in care delivery between 2010 and 2014.

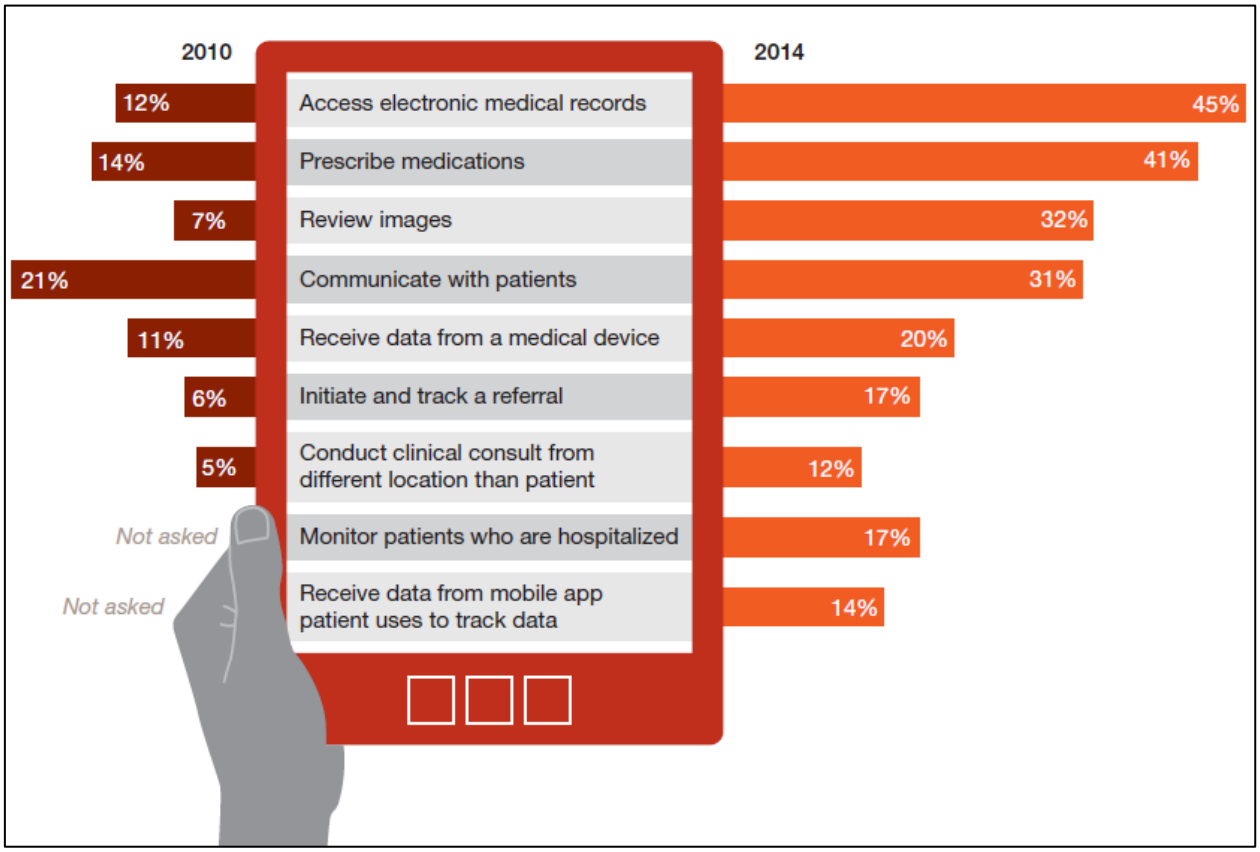


Figure 3: An overview of the use of mobile devices by heatlhcare practitioners (PricewaterhouseCoopers Health Research Institute, 2014)

Figure 3 illustrates a substantial rise in the utilisation of mHealth among healthcare practitioners. In 2014 the prescription of medication through mHealth was 41% while communication with patients was 31%, both up from 14% and 21% respectively in 2010 when the first survey was distributed.

2.4.2 *Healthcare intervention*

Chronic disease treatment plans often require continuous and coordinated care across various health skills and the mutual collaboration of several healthcare professionals (Kahn et al., 2010). Care coordination is the deliberate management of a patient's care, and information sharing among all healthcare practitioners who are looking after the patient's various illnesses in order to achieve better and more effective health outcomes (Agency for Healthcare Research and Quality, 2015).

mHealth caters for better communication and coordination of care, which result in improved patient health outcomes.

Although Kaplan (2006) looked at evidence of whether mobile phones could be an effective healthcare intervention tool in developing countries, he reasoned that it is difficult to form a general perception due to the outcome measurements of differing literature.

The recurring message at the 2012 mHealth conference held in South Africa was for low and middle income countries to intensify mHealth initiatives (Tomlinson et al., 2013).

2.4.3 *Benefits*

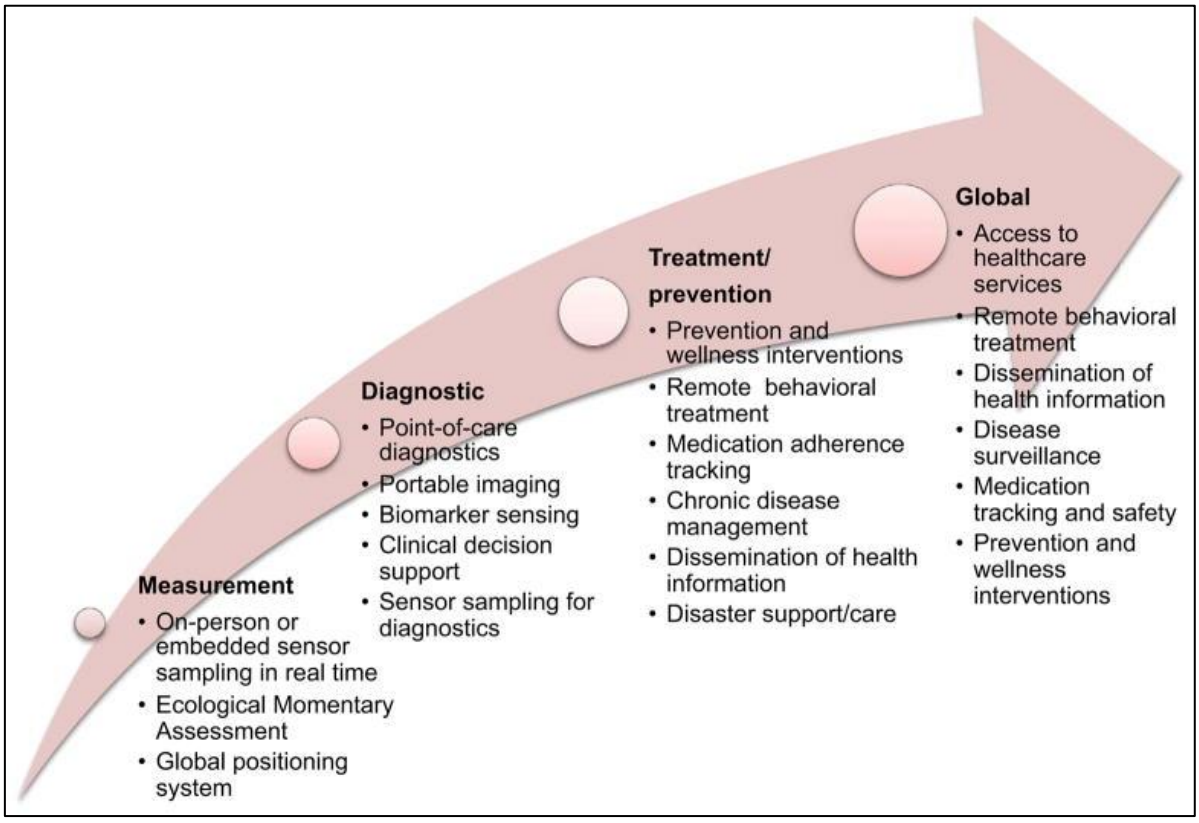


Figure 4: Continuum of mHealth Tools (Kumar et al., 2013)

Figure 4 provides an illustration of the spectrum and categorisation of available mHealth tools. The uses and benefits of mHealth are vast; this section will only

address the most commonly researched benefits which have the most significant value for healthcare consumers. These relate to the prevention and ongoing management or treatment of chronic conditions.

mHealth enhances communication between healthcare providers and patients, and with the rising incidence of chronic diseases, mHealth offers alternate care strategies for diagnosis and treatment (Kahn et al., 2010). One of the objectives of technology innovations in healthcare is to improve health service delivery (Källander et al., 2013; Mechael, 2009).

Mobile health can be used successfully in the following areas; education and awareness, data collection, remote patient monitoring, peer-to-peer communication among healthcare workers, diagnosis and treatment support (Klasnja & Pratt, 2012; Kumar et al., 2013). The added benefits of mobile health are the convenience it brings to users due to its accessibility. mHealth can also lead to better quality health services and possibly a reduction in the overall cost of care (Kumar et al., 2013). Mobile health services have the potential of reducing healthcare costs by lowering the disparities created by consumer income and geographical location.

Blaya, Fraser, and Holt (2010) maintain that assessments of mHealth have convincingly shown that mobile devices are effective in increasing the rate, time and quality of health data collection, however no other researchers have supported nor substantiated this view. Wu et al. (2007) state that mHealth systems can improve the quality of care, aid in service delivery, decrease the rate of clinical error and importantly aid in scaling real-time accessibility and management of patient care information. These benefits would provide tremendous advantages to patients and health practitioners.

Healthcare providers require real-time access to patient information and the ability to input data synchronously from anywhere, at any time (Wu et al., 2007), therefore they would also benefit from mHealth. Due to their compact design, smart devices are easy to carry which ensures that users are able to access data and essential services at the press of a button (Klasnja & Pratt, 2012; Sarker & Wells, 2003). The

location of an individual is no longer a barrier to communication or exchange of information (Silva et al., 2015).

mHealth benefits include the efficient use of resources and substantial location independence (Istepanaian & Lacal, 2003). The convenience of mHealth to the end users is the reduced time to access and receive health information as well as treatment.

Blaya et al. (2010) state that a systematic review of eHealth implementation strategies in developing countries show promise in improved communication, assistance in ordering and managing medication as well as in monitoring and detecting patients who might not adhere to care plans. Boulos et al. (2011) reiterate the immense potential for mobile technology to transform healthcare. Free et al. (2013b) urge that there is a need for high quality trials specifically aimed at measuring mHealth outcomes in a clinical setting.

Kahn et al. (2010) argue that vigorous implementation of mHealth may also advance non-health benefits such as fostering economic growth. This view is further supported by Beaglehole et al. (2011) who state that NCDs hinder countries' development goals such as the alleviation of abject poverty, equitable care and economic stability.

2.4.4 *Removing barriers to healthcare*

There is growing enthusiasm for the use of mHealth, however debates continue regarding the potential for considerable benefits of mHealth in heatlhcare service delivery particularly in resource poor areas (Free et al., 2013b). The PricewaterhouseCoopers Health Research Institute (2014) states that patients believe mHealth will improve access to care and lower healthcare costs.

The biggest draw card to mHealth is that mobile technology has the capability to solve the greatest barrier to global health efforts – equitable access to care (Tomlinson et al., 2013).

The lack of integration between medical records and mHealth systems were seen as another barrier to the expansion of mHealth (Istepanaian & Lacal, 2003). This barrier has since been addressed by the advent of Electronic Health Records (EHR). EHRs provide a single digitised record of an individual's health history. Healthcare providers are already integrating mobile technology in their health practices and in certain regions mHealth is being incorporated into the public sector (Mechael, 2009).

Chronic disease patients require equitable access to medication, health facilities (e.g. clinics) and all these have a cost factor (Kahn et al., 2010). Blaya et al. (2010) concede that evaluating the impact, positive or negative, of eHealth on patient outcomes is challenging. Reviews illustrated that there are few studies reflecting the effectiveness and cost benefit of eHealth in developing countries with the exception of data collection methods (Blaya et al., 2010). The same could be applicable to mHealth, therefore more focused research is needed to make a definitive determination.

2.5 Conclusion

The literature review highlighted two broad themes to illustrate the context and background of the research topic. The concepts presented are the adoption and acceptance of technology and the factors that would influence the utilisation of mobile technology in healthcare. Although extensive research has been conducted on mHealth strategies, the majority of the research took place in developed countries with little empirical research in emerging markets apart from text messaging services.

This study intends to add to the current body of work and outlines the opportunities presented by mobile technology in healthcare, particularly for the consumer of health services. Health practitioners, medical aid funders, and government need to realise the potential of mHealth and its value to chronic disease management. mHealth has the capacity to contribute positively to healthcare delivery while

lowering costs, increasing accessibility to care and delivering positive health outcomes for patients.

This research aims to explore the benefits of mobile health in curbing the prevalence of NCDs and encouraging patients to partake in the management of their chronic illness. mHealth will play a significant role in the delivery of care and fundamentally change the way the health sector provides healthcare and the manner in which patients interact with healthcare practitioners. Barriers to wide scale adoption such as the perception of high data costs, unreliable network connections and security concerns need to be overcome, however these are beyond the scope of this study.

mHealth technology will require the adjustment of health behaviour theories to enable greater expansion of mHealth in primary healthcare. Tomlinson et al. (2013) are hopeful that mHealth will minimise or eliminate current barriers to care.

2.5.1 *Proposition 1: South Africans are likely to accept and use mobile health services*

2.5.2 *Proposition 2: The potential benefits of mobile health services include:*

- Convenience and accessibility of healthcare services
- Reduction in the cost of healthcare provision
- Improved quality of care

CHAPTER 3. RESEARCH METHODOLOGY

Chapter 2 reviewed available research in respect of factors which influence the acceptance and adoption of technology and how mobile health technologies could be implemented for the benefit of healthcare consumers.

This chapter will outline the research methodology which was used to conduct the study. A quantitative methodology was selected for use in this study.

The decision to utilise a quantitative research methodology will be discussed and substantiated. Next will be a review of the research design and research instrument. Subsequently, an overview of the sample population and data collection will be provided. The validity and reliability of the study will also be presented.

3.1 Research methodology / paradigm

The purpose of this study was to ascertain the potential role mobile health technologies may have on disease management, specifically self-monitoring of chronic patients and maintenance of health status among high risk individuals in South Africa. The aim of the study was to determine the likelihood of mHealth acceptance and use, as well as the factors which influence people to adopt mHealth. Additionally the study sought to illustrate the potential benefits of mHealth and the role that mobile health services may have. In order to measure these factors, the study made use of a quantitative research approach.

A quantitative research approach tests the research theory by considering the relationship between variables, these variables are measurable and the data can be analysed through statistical methods (Creswell, 2014). This study follows a postpositivist view, this is determined by the need to measure and classify the variables which may influence the outcomes (Creswell, 2014). The analysis of the research data was executed through exploratory factor analysis.

A quantitative analysis is the most appropriate method for this research as it aims to measure the factors influencing the adoption of mobile technology and the

willingness of people to use mobile technology in the healthcare sector; both these propositions centre on human behaviour and attitude. Creswell (2014) supports the quantitative approach for measuring behaviour and attitude.

3.2 Research Design

The approach that was followed was the creation of a survey in the form of a questionnaire to collect primary data. The survey was cross-sectional, each respondent was able to complete the survey once and the selected answers could not be altered once the survey participant had clicked on the submit button. Cross-sectional studies are useful to researchers because they allow researchers to compare a number of variables at the same time. A cross-sectional study collects data from the sample population once, in comparison to a longitudinal study where data is collected several times over an extended period of time.

A questionnaire was the most suitable tool for this study as the researcher's intention was to assess the unique behaviour of different individuals towards mobile technology and its application in healthcare. Survey research offers a statistical narrative of trends, attitudes and preferences of a sample population (Creswell, 2014). Based on the objectives and sub-problems listed in Chapter 1 and 2, as well as the literature, the survey sought to establish if the sample population had the intent to use mobile technology and whether South Africans would adopt mobile health technology to track, monitor and maintain their health and wellbeing.

A structured survey designed specifically for this research was used. The survey examined the relationship between variables in the adoption of mobile technology and the integration of mobile technology in patient self-care.

3.2.1 *The advantages of using a questionnaire for this study*

The advantages of using a survey in the form of a questionnaire are listed below:

- A survey enables the researcher to collect data from a large sample of the population in contrast to interviews

- The results of the questionnaire can be collected and analysed within a short period of time
- The researcher is not be able to influence the respondents' answers
- A survey provides the researcher with less administrative tasks in comparison to a qualitative study
- An electronic survey is cost effective
- An electronic survey can be created in such a way as to force the respondent to answer each question thus eliminating the probability of missing or invalid data
- All the respondents receive the same questions therefore eliminating any bias on the part of the researcher

3.2.2 *The disadvantages of questionnaires*

The disadvantages of using a survey in the form of a questionnaire are listed below:

- It can be argued that the researcher cannot gauge the different emotions experienced by the respondents and whether these may affect their responses
- A limited set of questions is asked and the questions do not contain detailed explanations
- Answers to questionnaires cannot be tested for truthfulness
- Certain words or phrases may be interpreted differently by respondents based on their understanding

3.3 Population and sample

3.3.1 *Population*

The population consisted of individuals who are consumers of healthcare services, chronic and non-chronic patients. There were no restrictive conditions; technology acumen was not a requirement. The only demographic questions that respondents

were asked to complete were their age group and gender. Respondents' names, race and education levels were not relevant to this study.

3.3.2 *Sample and sampling method*

The sampling method utilised was random sampling. The sample included all age groups; healthy individuals, individuals who are currently on chronic medication, individuals with non-chronic illnesses, individuals who work in the medical aid industry, individuals in various private and public sector industries.

The survey was created on Qualtrics and distributed to the sample population via email. It was valuable for health consumers to participate in the survey to familiarise themselves with the potential benefits and barriers of mobile healthcare services as mobile technology will impact all healthcare touch points in the near future.

3.4 The research instrument

The research data was collected through the use of a closed questionnaire in the format of a structured survey. The purpose of a survey is to collect data from a sample that can be applied generally to the larger population (Creswell, 2014).

The survey was compiled on Qualtrics and distributed by email to approximately 500 people.

The questionnaire was split into the following major sections:

- The cover letter
- Demographics section
- Section on the health status and smart device ownership
- The major section of the questionnaire consisted of questions relating to;
    - Prior knowledge of mHealth
    - Intention to use MHS
    - Barriers and benefits to the uptake of mHealth
    - Factors which would influence the upscaling of mHealth use

- mHealth solutions or services

The body of the questionnaire made use of a 5 point Likert scale to rate responses on the constructs. The purpose of using the Likert scale was to enable the researcher to understand and interpret the perceptions of the respondents in relation to the factors which would influence the expansion of mHealth as well its potential barriers.

Below, Table 2 illustrates each factor that was analysed as well as the connection between the questions and the research propositions.

Table 2: Structure of the questionnaire

Proposition or Aspect	**Question number(s)**
Demographics and health status	1, 2, 3, 4, 5
Prior knowledge or exposure to mHealth	6
Proposition 1: South Africans are likely to accept and use mobile health services	7, 8
Proposition 2: The potential benefits of mobile health services	10, 12, 13
Potential barriers to mHealth	9
Factors influencing the uptake of mHealth	11

Appendices A1 and A2 contain the cover letter as well as the questionnaire that was used for the study.

3.4.1 *Advantages of using a questionnaire*

The main advantages of structured surveys are the possible reach and the quick turnaround time in collecting and analysing the data (Creswell, 2014). Each respondent receives the same set of questions and possible answers; therefore the data collected is in a standardised format.

Another advantage of using a questionnaire, an electronic survey in this case, is that it has wider reach thus ensuring that respondents can partake in the survey at any time from any location while remaining anonymous.

A closed questionnaire is easy to interpret once the data is collected due to the restricted answers made available to respondents.

3.4.2 *Disadvantages of using a questionnaire*

When the sample population is not random, the validity of responses could be affected by respondents' emotions and biases. Respondents have limited choices in terms of possible answers.

Another disadvantage of a survey that it is completed without the researcher being present and there is a risk that respondents may misunderstand questions and their answers could skew the results of the survey.

3.5 Procedure for data collection

The research data was collected through the use of a questionnaire in the format of a structured survey. The survey was created on Qualtrics and distributed to the sample population via email. The survey was distributed through email to MBA students at Wits Business School, colleagues in a small health information systems organisation as well as to employees of three different small to medium health and IT organisations working in the public and private health sectors in South Africa.

3.6 Data analysis and interpretation

The data analysis was conducted through the use of exploratory factor analysis. Exploratory factor analysis considers the relationship that exists between multiple independent variables. Factor analysis includes the procedures to identify the underlying factors and screening of variables.

Factor analysis is useful for the purposes of this study as the aim was to determine the attitudes of a sample population by examining the data for patterns, confirmation of the hypotheses and the reduction of variables to a manageable number (Williams, Brown, & Onsman, 2012).

Although there is no set criteria for the minimum sample size or respondents required in a survey aiming to apply exploratory factor analysis, it is widely

accepted that this data analysis method may be used where the sample size is at least 100 (Hair, Black, Babin, Anderson, & Tatham, 2006; Williams et al., 2012).

3.7 Limitations of the study

The limitations of this study are listed below:

- This research is exploratory and the survey questionnaire has not been used in previous research
- The research relies on the respondents' honest answers to all questions
- The survey was sent as a link in an email, therefore it is challenging to identify non-respondents as there is no way to ascertain who may not have clicked the link provided
- Due to the sample size and responses received, the research might be criticised for not being a representative sample for general application to the greater population
- The questions asked in the survey may represent the researcher's own prejudice, this means that the methodology may be limited by the researcher's abilities, sensitivity and bias
- The results of this study will only be applicable to the South African population

3.8 Validity and reliability

3.8.1 *External validity*

Validity focuses on whether or not the measure of a concept actually measures the said concept (Bryman, 2012). External validity refers to the ability to take the study's findings from a sample population and generalising the findings to a greater population. A high degree of external validity signifies that the results of the study can be applied in general terms to the rest of the population. In relation to this research, high external validity of the acceptance of mobile technology and its application in a healthcare setting may signal future trends in mHealth usage. To

ensure a high external validity for this research, a reasonable sample size of respondents was required.

3.8.2 *Internal validity*

Internal validity is concerned with causal relationships (Bryman, 2012). This study does not seek to determine a cause and effect relationship between mobile technology and mobile health technology trends; rather it aims to show that the implementation of mHealth may have significant benefits for chronic patients and other consumers of health services.

3.8.3 *Reliability*

Reliability refers to the accuracy of the measurement of a concept, and whether the instrument used produces consistent and stable results (Bryman, 2012). The researcher needs to consider people's ever changing preferences as these may affect the responses provided on the survey. To ensure high reliability in this study, the researcher designed the survey in such a way that an answer was mandatory for each question. This was to ensure that there is no missing data and enabled the researcher to accurately analyse all the variables in the results.

3.9 Demographic profile of respondents

The survey was distributed to approximately 500 individuals; a total of 174 individuals completed the survey. Two questions were asked at the beginning of the questionnaire to gain insight into the demographics of the respondents.

The responses relating to the demographic profile of the survey respondents are presented in this section.

3.9.1 *Age profile*

The respondents to the survey had to indicate their age group as this was a mandatory field. Figure 5 illustrates the breakdown of participants by age group.

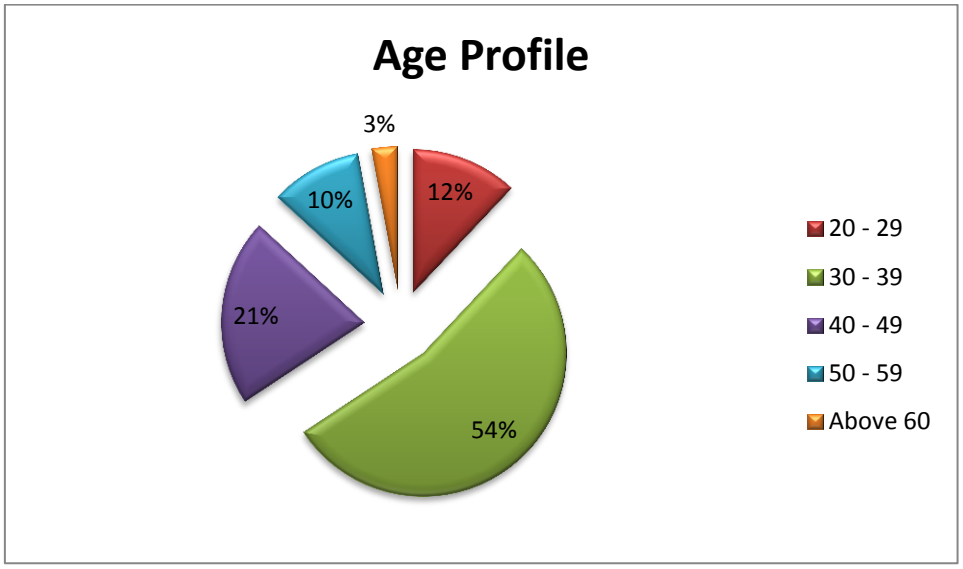


Figure 5: Age profile of respondents

The largest age group to participate in the survey was the 30 – 39 year olds.

3.9.2 *Gender profile*

The gender profile of the respondents is depicted in Figure 6 below.

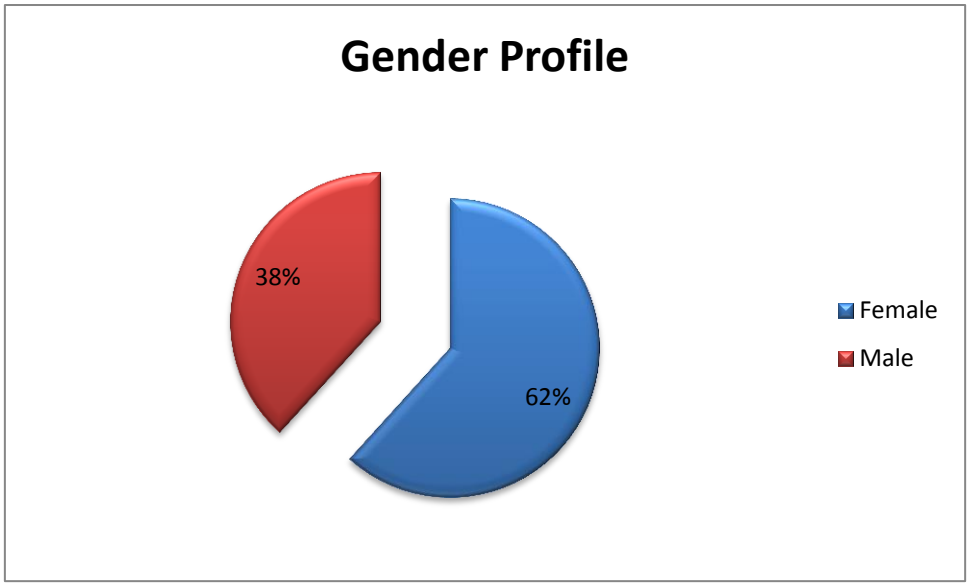


Figure 6: Gender profile of respondents

The majority of respondents were female at 62% with males making up the balance of 38%.

CHAPTER 4. PRESENTATION OF RESULTS

4.1 Introduction

The results of the survey are presented in this chapter. At this stage, there will be no in depth interpretation of the data as the interpretation of the results will be discussed thoroughly in chapter 5.

The full set of results produced is included in Appendices B to E, only the results that are pertinent to the analysis are included in this chapter.

4.2 Health status and Mobile device ownership

In this section the responses with regard to the health status of respondents as well as the rate of mobile device ownership are presented.

4.2.1 *Profile of current chronic patients*

Figure 7 illustrates the chronic disease profile of the respondents.

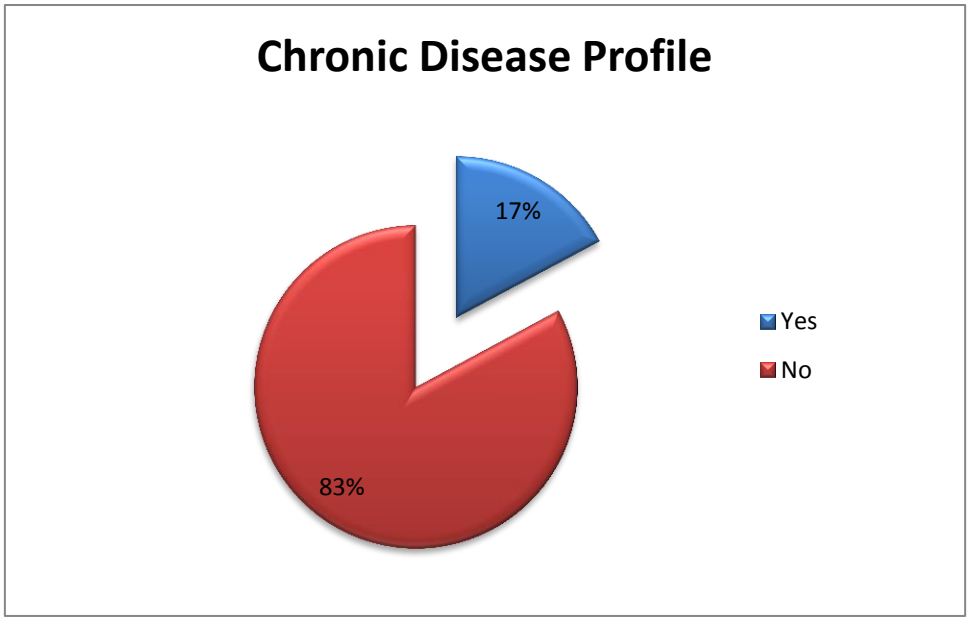


Figure 7: Chronic disease profile of respondents

The data shows that only a small percentage of respondents are currently suffering from a chronic illness.

4.2.2 *Profile of family history in respect of chronic diseases*

Figure 8 depicts the responses received in respect of respondents' family history of chronic disease.

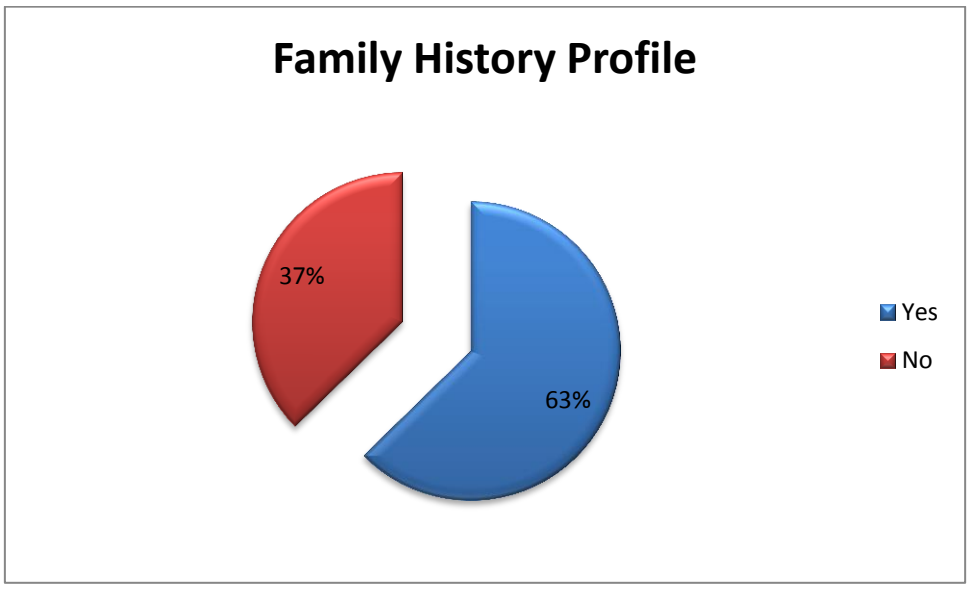


Figure 8: Profile of family history of respondents

The majority of respondents indicated that they have a family history of chronic disease.

4.2.3 *Ownership of a smart device*

The results pertaining to the ownership of various smart devices are illustrated in Figure 9 below.

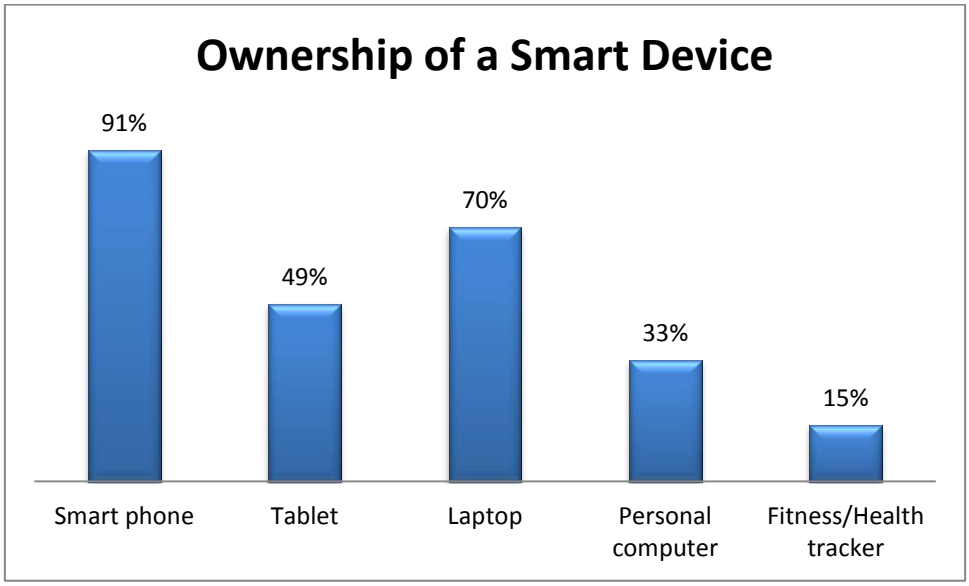


Figure 9: Profile of respondents who own a smart device

From the graph in figure 9, it is clear that smartphones have become common accessories. At least 91% of respondents own a smartphone.

4.3 Descriptive statistics and distributions

This section will provide an overview and a summary of the data collected. This section summarises the statistics for the key outcomes based on the research items from the questionnaire.

The dependent variable used in the data analysis was the Intention to use mHealth.

The presentation of the data will start with the hypothesis testing, followed by a brief overview of the mean and standard deviation, the factor analysis results, regression analysis and then the scale distributions.

4.3.1 *Hypothesis testing*

Table 3: T-test confidence

Heard of mHealth	Method	Mean	95% CL Mean		SD	95% CL SD	
Yes		6.1782	5.5824	6.7740	3.0179	2.6514	3.5030
No		5.1081	4.3387	5.8775	3.3210	2.8588	3.9630
Diff (1-2)	Pooled	1.0701	0.1189	2.0213	3.1494	2.8496	3.5202
Diff (1-2)	Satterthwaite	1.0701	0.1036	2.0366			

T-test

The purpose of using a t-test is to determine the statistical difference between the means of two groups (Lee, 2015). The difference in means is 1.0701 as indicated in Table 3. The difference in means is calculated by subtracting the mean of 5.1081 for health consumers who have not heard of mHealth from 6.1782, the mean for health consumers who have heard of mHealth.

Positive t-values indicate significance above the average responses while negative t-values point to significantly below average responses. The difference in means is above zero at 1.0701 and indicates that the means differ considerably from each other.

The calculated difference in the sample means is used to estimate the difference in population means. The confidence interval describes the accuracy of the estimate. The mean has a 95% confidence interval of 5.5824 to 6.7740 for respondents who have heard of mHealth. The mean has a 95% confidence interval of 4.3387 to 5.8775 for respondents who have not heard of mHealth.

Table 4: T-test p-values

Method	Variances	DF	T-Value	Pr > |t|
Pooled	Equal	173	2.22	0.0277
Satterthwaite	Unequal	148.4	2.19	0.0302

Table 5: Equality of variances

Equality of Variances				
Method	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Folded F	73	100	1.21	0.3726

P-value

In hypothesis testing, p-values assist in determining the significance of the results. Hypothesis tests assess the validity of the null hypothesis; the hypothesis that is being tested is whether the data has an equal variance. The p-value of a t-test indicates the probability of the *t* variable falling further away from the mean than the observed value of *t.*

The p-value does not confirm whether the null hypothesis is correct or incorrect. Pr>|t|<0.5 suggests that there is a significant difference within a 5% confidence interval. The values for Pr>|t| are shown in Table 4 above.

Table 5 displays the significance values for the equality of variances test. The p-value is high as Pr>F is 0.3726; therefore the assumption is that the variances between the two groups is equal and the equal variances test is accepted.

4.3.2 *Mean and standard deviation*

The difference between the means of the respondents who know of mHealth and those who do not know of mHealth is 1.0701. The difference in means is statistically significant at a 95% confidence interval as the value is entirely above zero. A small standard deviation, as experienced in this data set signifies a small dispersion from

the mean. This indicates that on average, the respondents' answers did not vary remarkably and therefore the results of the analysis can be comfortably applied to the greater population.

In Table 6 and in the rest of this paper, SD refers to Standard deviation.

Table 6: Mean and standard deviation

Research item	N	Mean	SD
Medication reminder services	174	-0.0194	1.26
I care about the quality of care I receive	174	0.0333	1.18
I want to be involved in the healthcare decisions being taken about my health	174	-0.0481	0.96
I want to improve the communication between myself and my healthcare provider	174	0.0125	1.12
Convenience, the ease with which I access healthcare services is important to me	174	0.0326	1.07
Mobile health services will make it more convenient for me to access a healthcare provider and health services	174	-0.0195	1.13
Mobile health services will make it easier to access to health or medical related information	174	-0.0632	0.84
Mobile technology will empower me to track and manage my health at my own pace and in my own time	174	-0.0211	0.82
Mobile health services may lead to a reduction in healthcare costs	174	-0.0263	0.81
Mobile technology may increase the level of quality of the care I receive	174	-0.0472	1.01
mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	174	0.0439	0.77
mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	174	0.0508	0.75
mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	174	0.0464	0.75
Mobile health solutions will enable me to be more involved in the management of my health status	174	0.038	0.79
Mobile health services will improve the relationship I have with primary healthcare provider	174	0.0254	0.92
Privacy and confidentiality are important to me	174	0.3716	0.89
I care about the quality of care I receive	174	0.6695	1.05

Research item	N	Mean	SD
I want to be involved in the healthcare decisions being taken about my health	174	0.5028	1.12
I want to improve the communication between myself and my healthcare provider	174	0.2458	0.9
Convenience, the ease with which I access healthcare services is important to me	174	0.4992	1.08
Mobile health services will make it more convenient for me to access a healthcare provider and health services	174	-0.2516	0.69
Mobile health services will make it easier to access to health or medical related information	174	-0.1417	0.64
Mobile technology will empower me to track and manage my health at my own pace and in my own time	174	-0.0997	0.71
Mobile health services may lead to a reduction in healthcare costs	174	-0.3192	0.88
Mobile technology may increase the level of quality of the care I receive	174	-0.3131	0.8
mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	174	-0.2407	0.69
mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	174	-0.275	0.79
mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	174	-0.318	0.71
Mobile health solutions will enable me to be more involved in the management of my health status	174	-0.1744	0.65
Mobile health services will improve the relationship I have with primary healthcare provider	174	-0.3299	0.77

4.3.3 *Factor analysis results*

The factor analysis of the research items is detailed in this section. Using the factor analysis program within the SAS system assisted the researcher in determining the underlying factors which were statistically significant for the purposes of this study.

The scree plot depicted in Figure 10 indicates that 5 factors had eigenvalues greater than 1, however only 2 factors were statistically significant and therefore extracted. An eigenvalue signifies the variance of a specific factor.

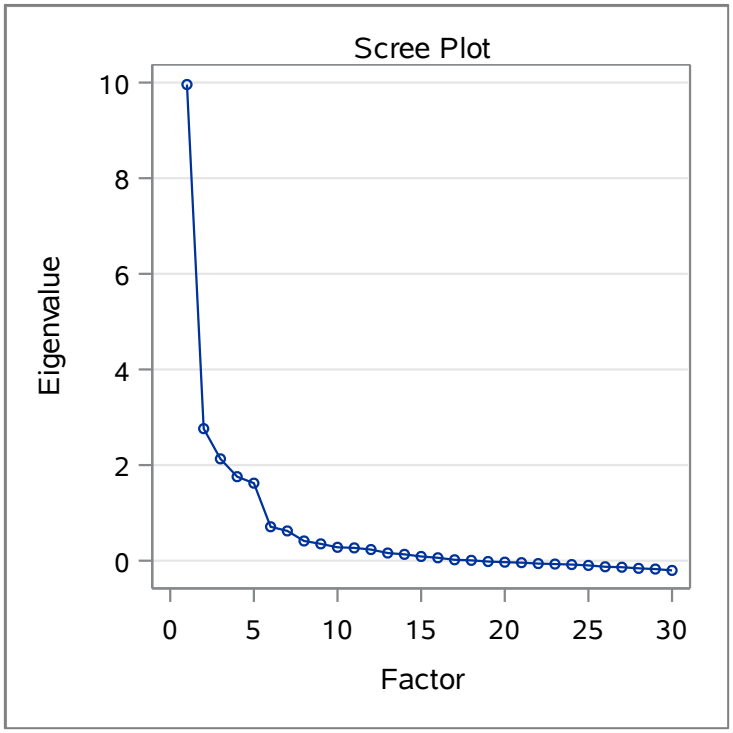


Figure 10: Plot of Eigenvalues

The two factors identified as having a significant impact on the willingness and likelihood toward the acceptance and utilisation of MHS are factor 1 and factor 3. These have been categorised as; *mHealth drivers* and *mHealth tools* respectively. The mHealth drivers encompass the attributes that would influence people to use mobile health solutions, while mHealth tools are the actual services which people are most likely to use.

The dependent variable chosen for the analysis of the research data were the *intention or likelihood to use mHealth in the next 12 months.* This item was question 7 in the survey.

Table 7 below, provides a detailed view of the results of the Factor Analysis performed. Factors 1 and 3 are the most significant drivers, indicating the behavioural intention to use mHealth and the perceived benefits of mobile health.

Items with a factor loading of less than 0.45 were removed from the table for clarity.

Table 7: Factor Analysis

Rotated Factor Pattern	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Medication reminder services			0.57589		
Health tracking tools e.g. step counters, weight tracker			0.70458		
Remote consultation			0.61993		
Fitness and health management apps (including electronic health/medical records)			0.80248		
General fitness, health and medical education tools			0.79751		
Affordability of mobile network services e.g. data, airtime					0.71215
Patient's discomfort with changes to healthcare regimen					0.67324
Resistance from healthcare providers, medical aid schemes and health insurers					0.57085
Lack of minimum standards and regulation slowing the pace of innovation					0.57306
Affordability of smart devices e.g. smartphones , tablets					0.76999
Greater access to health services and treatment		0.7596			
Improved interactions between healthcare providers and patients		0.81298			
Increased adherence to disease management/treatment plan		0.78654			
Increased efficiency in the delivery of health services at primary healthcare provider i.e. doctor or clinic		0.80385			
Reduction in cost of healthcare services		0.59731			
Privacy and confidentiality are important to me				0.7045	
I care about the quality of care I receive				0.77332	
I want to be involved in the healthcare decisions being taken about my health				0.70079	
I want to improve the communication between myself and my healthcare provider				0.67087	
Convenience, the ease with which I access healthcare services is important to me				0.69937	
Mobile health services will make it more convenient for me to access a healthcare provider and health services	0.69603				
Mobile health services will make it easier to access to health or medical related information	0.62086				

Rotated Factor Pattern	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Mobile technology will empower me to track and manage my health at my own pace and in my own time	0.69236				
Mobile health services may lead to a reduction in healthcare costs	0.71744				
Mobile technology may increase the level of quality of the care I receive	0.81145				
mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	0.79735				
mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	0.7384				
mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	0.80977				
Mobile health solutions will enable me to be more involved in the management of my health status	0.74733				
Mobile health services will improve the relationship I have with primary healthcare provider	0.75394				

The retained factors were renamed in order for their titles to be representative of the grouped items. Table 8 provides the details of the renamed factors.

Table 8: Renamed factors

Variable factor	Renamed factor
Factor 1	mHealth drivers
Factor 2	Consumer Benefits
Factor 3	mHealth tools
Factor 4	User acceptance considerations
Factor 5	Possible barriers

4.3.4 *Regression analysis*

Table 9: Analysis of variance (ANOVA)

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	715.04192	357.52096	68.22	<.0001
Error	139	728.42991	5.24050		
Corrected Total	141	1443.47183			

Lee (2015) describes the ANOVA F statistic as a formal significance test of fit. The F statistic is used to test the accuracy of R-square. The F statistic is also applied in error estimates; Sum of Squares and Mean Square.

The p-value of the ANOVA provides evidence which supports the theoretical ideal that the data fits on a straight line. The *Pr > F* column in Table 9 indicates the p-value which in this case is < .0001, this is an indication that based on the error estimates the F static is a good fit to the model of the study.

Table 10: Fit statistics for R-square

Root MSE	2.28921
Dependent Mean	5.51408
R-Square	0.4954
Adj R-Square	0.4881
AIC	382.17914
AICC	382.47111
SBC	247.04662

The ANOVA F-value and size of R-square are related. The size of R-square is used to measure the regression fit and the ANOVA measures the accuracy which tests that R-square is greater than zero. This is due to the fact that an R-square equal to zero means that the data does not fit a straight line.

R-square is also used to explain the variance of the dependent variable. The size of R-square often lies between 0 and 1. An R-square value close to 1 better explains the dependant variable variance (Lee, 2015). Table 10 shows that the R-square is sized at approximately 0.5 which equates to 50% of the dependant variable variance as defined by the straight line.

Parameter estimates

Table 11 illustrates the regression outputs; this table illustrates and supports the significance of the 2 factors.

Table 11: Table of parameter estimates

Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**T-Value**	**Pr > |t|**
Intercept	1	5.514085	0.192107	28.70	<.0001
mHealth drivers	1	1.217572	0.200082	6.09	<.0001
mHealth tools	1	2.000074	0.207516	9.64	<.0001

The outputs of this regression indicate that the constant intercept is 5.514085. The dependent variable used in the data analysis was the likelihood to accept and use mHealth. Consequently the regression line is a good predictor that at least 55% of the survey respondents would use mobile health services.

4.3.5 *Scale Distributions*

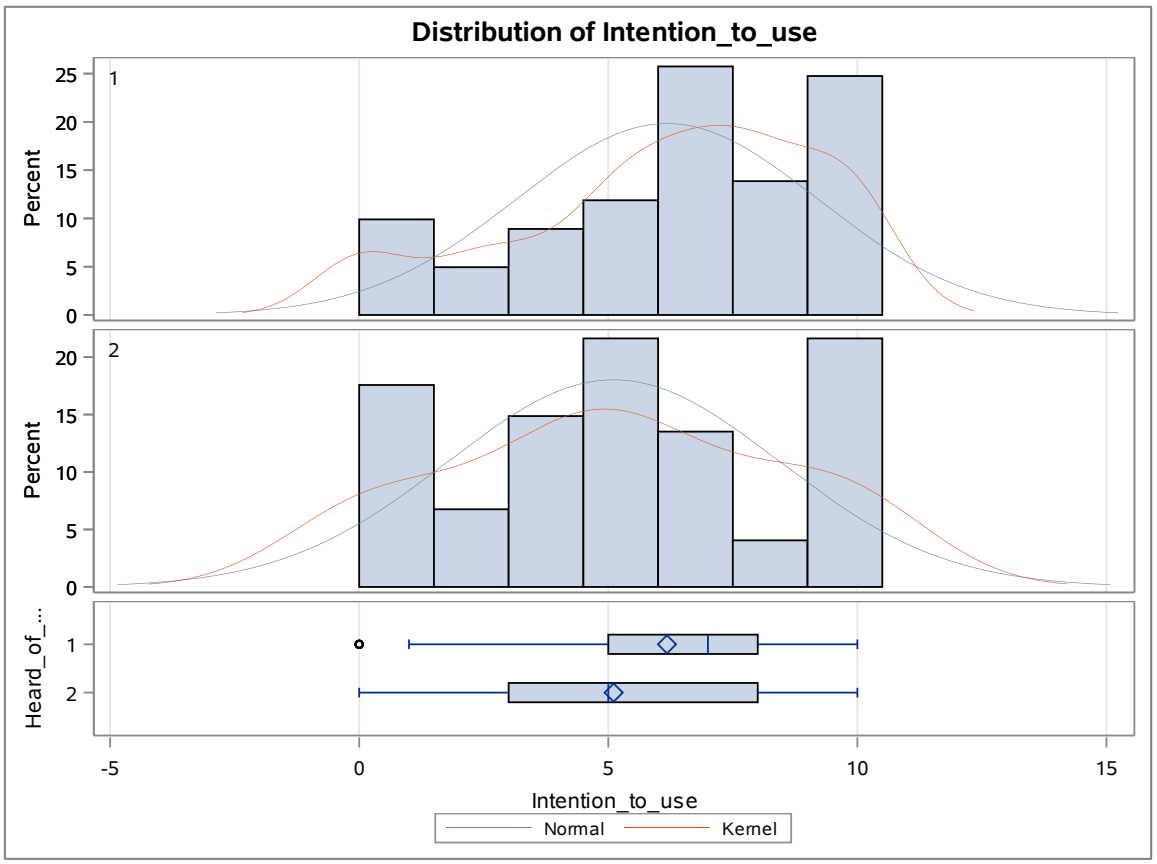


Figure 11: Distribution for Intention to use mHealth

The distribution of responses to the question relating to the Knowledge of mHealth and Intention to use mHealth is represented in Figure 11 above. The first graph illustrates the distribution of respondents who know of mHealth. The second graph shows the distribution of respondents who have the intention to use mHealth services.

The blue lines identify the normal or expected distribution of results. The red lines indicate the actual distribution of the survey results. Both graphs show that the variables are normally distributed. In the normal distribution most of the responses cluster near the middle and the rest of the data is evenly spread on either side of the middle.

4.4 Results relating to the likelihood to accept and use mobile health services

The first proposition put forward in chapter 2 was that South Africans are likely to accept and use mobile health services.

The distribution graph in Figure 11 illustrates a normal distribution to use mobile health services. Therefore the results of the survey suggest that the average person would likely accept and use mHealth to monitor, maintain or manage their health status.

4.5 Results relating to the potential benefits of mobile health services

The second proposition put forward in chapter 2 refers to the potential benefits of mobile health services. This proposition was tested by questions 10 and 13. Based on the factor scores on the research items in table 6 above; the respondents believe that mobile health services offer convenience and increased access to healthcare services, have the potential to reduce the cost of healthcare as well as to improve the quality of care.

These indicate that the respondents rate these items as the primary benefits to the expanded use of mHealth.

4.6 Summary of results

A presentation of results was provided by the researcher in this chapter as well as an overview of the meaning of the results. The first part of the chapter illustrated the health status and smart devices owned by the survey participants. Second was the descriptive analysis of the significant research items and last the factor analysis results.

The results of the survey were analysed through the use of the statistical system SAS and Microsoft Excel. The results will be discussed in more detail in chapter 5. The purpose of this chapter was merely to provide a high level view of the results from the questionnaire and to set the foundation for a discussion of the established factors. The most relevant factors identified were factors 1 and 3; the *mHealth drivers* and *mHealth tools.*

CHAPTER 5. DISCUSSION OF RESULTS

In this chapter the researcher will interpret and discuss the results presented in the preceding chapter.

5.1 Introduction

When the survey responses were analysed, a total of 174 responses were used to perform the analysis. Two questions were asked to gain insight into the demographics of the respondents. These questions related to the age and gender of the respondents. The majority of respondents, 54% were between the ages of 30 and 39 years, while 62% of respondents were female.

The analysed survey results will be discussed in four sections;

- A discussion of the respondents' health status and ownership of mobile devices
- Detailed discussion and review of descriptive statistics
- A discussion of the results pertaining to the likelihood of accepting and using MHS
- A discussion of the results pertaining to the potential benefits of MHS

5.2 Health status and Mobile device ownership

This section contains a discussion of the current health status of the respondents, their family history and an overview of the mobile devices they own.

5.2.1 Profile of current chronic patients

Regarding the current health status of the respondents; 17% of the respondents indicated that they have been diagnosed with a chronic disease. The chronic conditions specifically referred to are Diabetes, Hypertension, Hyperlipidaemia and heart related illnesses. Therefore 83% of the respondents have not been diagnosed with a chronic

illness; the inference that can be drawn is that these individuals are in good health at present.

These figures are inconsistent to the results of the 2014 General Household Survey which reported that 31,8% of South Africans rated their overall heath as good, 23,9% rated their health as very good and 33,6% as excellent (Statistics South Africa, 2015). However this may be attributable to the fact that different questions were asked to determine the health status, also some chronic patients could rate their health as good if they were adhering to their treatment plan.

5.2.2 Profile of family history in respect of chronic diseases

The results of the question regarding the respondents' family history in respect of chronic illnesses revealed that 63% of the respondents had a family history of Diabetes, Hypertension, Hyperlipidaemia and heart related illnesses. Only 37% of the respondents indicated no history of chronic illnesses in their families.

Although only a small segment of the respondents are chronic illness sufferers, a larger percentage of respondents have a family history of chronic illness.

5.2.3 Ownership of a smart device

The question relating to the ownership of smart devices catered for more than one answer choice. Of the total respondents, 91% confirmed that they owned a smartphone, 70% indicated that they owned a laptop, 49% own a tablet and 33% own a personal computer. A small number of respondents, 15%, own a fitness or health tracker such as a Garmin or Apple watch.

These results substantiate the assertions regarding the pervasiveness and popularity of smartphones in society (Klasnja & Pratt, 2012; Sarker & Wells, 2003).

5.3 Detailed discussion and review of descriptive statistics

All responses to the questionnaire were collected, sorted and analysed using the statistical program SAS, and Microsoft Excel.

5.3.1 Hypothesis testing

T-test

A t-test is used to calculate the statistical difference between the means of two groups (Lee, 2015). The t-test results in Table 3 above, show the difference in means as 1.0701. This figure is the result of subtracting 5.1081 (mean of health consumers who have not heard of mHealth) from 6.1782 (mean of health consumers who have heard of mHealth).

A positive t-value signifies above average responses while a negative t-value represents significantly below average responses. The difference in means is 1.0701, which is greater than zero and indicates that the means differ considerably from each other.

P-value

P-values assist in determining the significance of the results. Hypothesis tests assess the validity of the null hypothesis; the hypothesis that is being tested is whether the variance in the data is equal.

The p-value is a probability test and not a test of whether the hypothesis is right or wrong.

Table 5 displays the significance values for the equality of variances test. The p-value is high as Pr>F is 0.3726; therefore the assumption is that the variances between the two groups is equal and the equal variances test is accepted. Since the p-value of 0.3726 is greater than the widely accepted significance level of 0.05, the null hypothesis cannot be rejected.

5.3.2 Mean and standard deviation

The difference between the means of the respondents who know of mHealth and those who do not know of mHealth is 1.0701. The difference in means is statistically significant at a 95% confidence interval as the value is entirely above zero. A small standard deviation, as experienced in this data set signifies a small dispersion from the

mean. This indicates that on average, the respondents' answers did not vary remarkably and therefore the results of the analysis can be comfortably applied to the greater population.

5.3.3 Factor analysis

As discussed in the preceding chapters, exploratory factor analysis was conducted on the survey data in order to find the factors that determine the likelihood of South Africans' acceptance of MHS as well as the potential benefits that can be gained from the use of mHealth.

The dependent variable used in the analysis of the research data was the *intention or likelihood to use mHealth in the next 12 months.* This item was question 7 in the survey.

The results of the Factor Analysis indicate two statistically significant factors, factor 1 and 3. These are the drivers which determine the behavioural intention to use mHealth. The factors are *mHealth drivers* and *mHealth tools***.**

The *mHealth drivers* relate to quality, convenience and accessibility, as well as healthcare cost reduction. Interestingly these are the same attributes that respondents indicated as the potential benefits of using mHealth. People are drawn to mHealth because it provides convenience, it has the potential to reduce the costs of healthcare delivery, and it encourages patients to be active in the management of their own health through the accessibility of health information and services.

5.3.4 Regression analysis

There is a strong correlation between the intention to use mHealth and the prior knowledge of mHealth.

The regression analysis determined that the R-square is close to 50%. The R-square indicates the variance percentage by which the dependant variable is accounted for based on the slope of the regression line (Lee, 2015). For the purposes of this research the value of R-square is a good fit to the sample size and to the data. A study covering

this particular subject has not been published in South Africa making is difficult for the researcher to infer with certainty whether the value of R-square is a perfect fit or not.

Analysis of variance (ANOVA)

The F-statistic is a test of fit and is also used to test the accuracy of R-square. The F-statistic is applied in error estimates; it is specifically applied to the Sum of Squares and Mean Square.

The p-value of the ANOVA supports the theory that the data fits to a straight line. The p-value in this case is < .0001 which is an indication that based on the error estimates the F-statistic is at a significance level of .01.

Fit statistics for R-square

The ANOVA F-value is related to the size of R-square. The size of R-square is used to measure the regression fit, while the ANOVA is used to measure accuracy. The F-value is further used to test that R-square is not equal to zero. An R-square equal to zero infers that the data does not fit a straight line.

R-square is also used to explain the variance of the dependent variable. The size of R-square often lies between 0 and 1, the closer R-square is to 1 the greater the variance is in the dependant variable (Lee, 2015). Table 11 shows that the R-square is sized at approximately 0.5 which equates to 50% of the dependant variable variance as defined by the line.

Parameter estimates

The outputs of this regression indicate that the constant intercept is 5.514085. The dependent variable used in the data analysis was the health consumer's likelihood to utilise mHealth. The regression line is a good indicator that at least 55% of the respondents would use mobile health services due to its perceived benefits.

Scale Distributions

The distribution of responses to the question relating to the Knowledge of mHealth and Intention to use mHealth is represented in Figure 11 above.

The blue lines illustrate the expected (normal) distribution of results. The red lines in both graphs show that the variables follow a normal distribution curve.

Graphs depicting a normal distribution will have the majority of responses clustered towards the middle and the rest of the data is spread evenly on either side of the middle.

The results provide a clear indication of the likelihood and intention of South Africans to make use of mHealth, this finding is supported by the research of Kim and Chang (2007) who assert that due to the usefulness of mHealth users had a positive intention to use it.

5.4 Discussion on likelihood to accept and use mobile health services

The survey respondents indicated that they are likely to use mobile health services. The mean response was 6.1 or 61%, indicating that the majority of the population would indeed make use of mobile health due to its potential benefits.

This result is significant as it illustrates that South Africans have a positive behavioural intention to use mHealth. The likelihood to adopt and use mHealth supports the findings that mobile health services can enhance existing healthcare strategies (Kahn et al., 2010; Wu et al., 2007).

5.5 Discussion on the potential benefits of mobile health services

The second proposition refers to the potential benefits of mobile health services. These are convenience and accessibility, cost reduction and increased quality care. These benefits are discussed below.

5.5.1 Convenience and accessibility

The research items relating to convenience and accessibility recorded high factor scores. The research item *mHealth solutions and services will make the provision of healthcare more convenient and accessible for me* had a factor score of 0.800. This further indicates that South Africans would adopt health services offered on mobile devices due to their perception that healthcare services and health information would be more accessible. Kahn et al. (2010) state that mHealth enhances communication between patients and their healthcare providers which supports the results of the data analysis. Further, accessing these health services would be less cumbersome and therefore more convenient in contrast to traditional methods such as queuing at a doctor's consulting rooms.

Boulos et al. (2011) confirm that mobile technology can enrich service delivery in healthcare due to its convenience. Tomlinson et al. (2013) also suggest that mHealth can remove access barriers to care. mHealth can improve access to healthcare services as it enables patients to receive health information instantly regardless of their geographical location. The added benefit is convenience as the patient does not have to exert much effort when in need of care; they are able to access and receive services at any time.

5.5.2 Cost reduction

Cost is central to the issue of healthcare delivery. Private healthcare in South Africa is quite expensive. It is no surprise that the research items associated with the reduction of health costs also had high factor scores; 0.715 and 0.746 for *mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work* and *Mobile health services may lead to a reduction in healthcare costs,* respectively.

The PricewaterhouseCoopers Health Research Institute (2014) survey results show that patients believe mHealth will reduce the cost of healthcare. Cost reduction strategies are imperative in South Africa where almost three quarters of the population cannot

afford private medical aid and rely on the state for care (Harris et al., 2011; Statistics South Africa, 2015).

5.5.3 Quality

Respondents to the survey expressed confidence in the potential of mobile health services and solutions to impact the quality of care. The eigenvalue for the research item *mHealth solutions and services will have a positive impact on the quality of healthcare services I receive* was 0.821 indicating a strong correlation to the acceptance and use of mHealth.

Quality is an important variable in healthcare, the results of the data analysis show that the level of quality of health services is essential to the respondents. This is also evidenced by the eigenvalue of 0.0806 for research item *Mobile technology may increase the level of quality of the care I receive.* South Africans are concerned with the level of care received and believe that one positive effect of using mHealth would be an increase in the quality of care.

5.6 Conclusion

The research conducted for this report, and the review of literature, shows compelling evidence in support of the two propositions' acceptance as probable and reasonable. Both propositions have been upheld by a detailed analysis of relevant questions and the factors determined by the data analysis. Further to this, the literature also supports the findings of the research. In their research Boulos et al. (2011) and Kahn et al. (2010) state that technology has great potential to transform the healthcare industry. The respondents to the survey used for this study certainly agree as they indicates that they would use mHealth and believe that there are great benefits to be gained from mHealth.

Through their responses, the study's respondents emphatically believe that mHealth would be beneficial as it would make healthcare more accessible, convenient and will reduce the overall cost of healthcare provision while increasing the quality of health services.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Chapter 5 provided a discussion of the results from the data analysis and results presented in chapter 4. In this chapter the researcher provides a summary and the concluding remarks on the research that was undertaken. In addition, recommendations are made to various stakeholders.

The aim of the research was to address the problem stated in chapter 1, which was to understand the factors that might influence people's willingness to adopt and use mobile devices to manage or maintain their health status.

The sub-problems listed were as follows:

Sub-problem 1: To analyse South Africans' intention and willingness to use mobile health

Sub-problem 2: To identify the factors influencing the acceptance and use of mobile health services

These sub-problems provided the foundation of the research propositions which were;

Proposition 1: South Africans are likely to accept and use mobile health services

Proposition 2: The potential benefits of mobile health services include:

- Convenience and accessibility of healthcare services
- Reduction in the cost of healthcare provision
- Improved quality of care

The survey results presented in chapter 4 affirmed the principles of both propositions. The respondents were likely to use mobile health and the respondents confirmed that mHealth is convenient and accessible, likely to reduce healthcare costs and would probably improve the quality of care.

6.2 Conclusions of the study

6.2.1 *South Africans likelihood to accept and use mobile health services*

With regard to proposition 1, more than half of the respondents indicated that they would use mobile health services within the next twelve months. Consequently the first proposition is accepted as the study found that South Africans intend to make use of mobile health services to monitor and manage their health status.

6.2.2 *The potential benefits of mobile health services*

The purpose of proposition 2 was to determine the benefits of mHealth and the factors that would influence South Africans to use mHealth. The analysis of the questionnaire responses supported the hypothesis that the potential benefits of mobile health were; convenience and accessibility of healthcare services, reduction in the cost of healthcare provision and improved quality of care.

The results were analysed through the use of exploratory factor analysis. The survey results indicate that the respondents recognise the potential benefits of utilising mHealth as part of their health management. Although the researcher had not hypothesised the specific mHealth solutions that healthcare consumers would use, the results show that consumers would make use of;

- Health tracking tools such as step counters
- Fitness and health management apps (including electronic health/medical records)
- General fitness, health and medical education tools

These items were extracted based on their high factor scores in the factor analysis.

6.3 Recommendations

The outcome of this research supports the need for extensive research into the area of mHealth within the South African health landscape and affirms the principle that

healthcare consumers should be more actively involved in the management of their own health.

In this section the researcher details a number of recommendations for the various stakeholders in the healthcare ecosystem as well as for health researchers.

6.3.1 *Healthcare policymakers*

Healthcare policymakers include the government, health lobby groups and local or international non-profit organisations concerned with the enhancement of healthcare delivery and health outcomes.

Policymakers are responsible for drafting the health strategy and are instrumental in the shaping of future health policy; hence they are integral participants in the health ecosystem. The results of this research indicate that healthcare consumers are ready to embrace mHealth, government and its partners are essential to the wide adoption of mHealth as they have more reach than private business and are best placed to disseminate information about the benefits of mHealth.

Suggestions on the role that policymakers can play are listed below, largely based on the result of the research data analysis and literature review:

- Government needs to partner with private healthcare funders, health provider groups and heath information technology companies in order to draft an mHealth strategy
- The mHealth strategy needs to integrate with the existing public health strategies and should not be a stand-alone project
- The results of the research demonstrate little resistance from health consumers however more education initiatives will need to be undertaken in order to dispel any fears or potential resistance to the acceptance of mHealth
- The government as well as other stakeholders in the public and private health sectors need to develop applicable mHealth standards
- Legislation would need to be enacted to regulate the use of MHS, this will enable the relevant oversight bodies to impose sanctions on entities that do not comply with the pre-determined mHealth standards

- Policymakers should pilot the implementation of an mHealth strategy in primary health especially in under resourced areas
- Policymakers should ensure that existing privacy legislation such as the Protection of Personal Information Act is modified to include sections on the storage, access to and distribution of patients' health information to ensure that the confidentiality and privacy of patients and their health data is maintained

An integrated, scalable mHealth strategy is required to maximise the benefits and impact of MHS. The adopted strategy would need to cater for an incremental integration of MHS into primary healthcare along with a more patient centred approach to healthcare delivery. As with any strategy, the rollout of MHS requires detailed planning, ongoing monitoring of progress and where necessary, adapting the strategy to the particular environment.

6.3.2 *Healthcare funders*

Healthcare funder is a term that refers to medical aid schemes, medical aid administrators, health insurers and regulatory bodies that oversee the industry.

The main role of healthcare funders is to educate healthcare consumers on their rights in respect of health services. Healthcare funders would have the additional duty to educate consumers on the use and benefit of mHealth. Is it widely accepted that private healthcare costs rise higher than inflation each year. mHealth has the potential to reduce overall health costs and this decrease would also benefit private health funders who would be able to curb spiralling care delivery costs.

In addition, healthcare funders should be accountable for the following:

- Enable the ongoing communication between healthcare providers and patients with the aid of mobile technology
- In association with healthcare policymakers, funders can create one central repository of EHR to enable care coordination among the different healthcare practitioners who are treating a single patient and reduce duplication of health data and document storage

- Funders, along with policymakers should encourage healthcare providers to reengineer care delivery and service processes to take full advantage of the efficiencies offered by mHealth and other health technologies
- Funders should partner with specialist mobile app developers and health IT companies to enable the creation of innovative solutions that are tailored to South African health consumers
- Should uphold all legislation relating to the use, maintenance and management of confidential patient health data

6.3.3 *Researchers*

Researchers are essential in uncovering the impact of industry changes on the end consumer, in this case the patient or health consumer. Further research is required to ascertain the short and long term benefits of mHealth on health outcomes. The research needs to be conducted with a larger sample size.

The scope for future research is vast; however the following have been identified as possibilities to be explored in the near future:

- The results of chronic patient self-management over an extended period
- The link between a healthier population and lower healthcare costs
- Information security and privacy in healthcare with regard to the use of mobile technology
- The efficacy of mHealth in prolonging the onset of chronic illnesses in high risk individuals

Greater collaboration is required between the public and private sectors in order to promote research initiatives and to raise funds so that important research may be undertaken to explore mHealth advantages.

6.4 Conclusion

The adoption and utilisation of new technologies in the prevention and management of chronic disease is vital for improving patient involvement in self-care. Mobile

technologies have become a part of daily life, are easy to use and affordable. Therefore mobile technologies can be used in healthcare delivery.

There are numerous factors which are currently driving the adoption of mHealth, changing lifestyles, consumer preferences and innovation. The results of this study show that the key mHealth drivers for South Africans are the quality of health services, the cost of healthcare provision, accessibility and convenience. Further research, with a larger population size is required to supplement these findings and to assess the long term benefits of using mHealth for the self-management of chronic diseases.

Respondents to the survey showed considerable likelihood of using mHealth. This is due to the considerable benefits offered by mHealth. The specific services that would be used wold include but would not be limited to; fitness and health self-management, sourcing health information, remote consultations and medicine reminder services.

mHealth provides a platform for the self-management of chronic conditions, and supports a proactive approach to better health through preventative measures such as health status tracking and ongoing monitoring of vital health data. Mobile technologies add a level of efficiency at a reduced cost, while geographical location is no longer a barrier to equitable and cost efficient care.

Mobile technology has brought the world closer and consumers are eager to have an active role in their own health. The various stakeholders all have a role to play to ensure that the full potential of mHealth is realised and optimised to benefit South Africans, particularly as the country struggles with the increase in preventable lifestyle diseases.

REFERENCES

Agency for Healthcare Research and Quality. (2015, May). Care Coordination. Retrieved from http://www.ahrq.gov/professionals/prevention-chronic-care/improve/coordination/index.html

Akter, S., & Ray, P. (2010). mHealth - an ultimate platform to serve the unserved. *IMIA Yearbook of Medical Informatics, 49*(1), 75-81.

Beaglehole, R., Bonita, R., Horton, R., Adams, C., Alleyne, G., Asaria, P., . . . Casswell, S. (2011). Priority actions for the non-communicable disease crisis. *The Lancet, 377*(9775), 1-10.

Blake, H. (2008). Innovation in practice: mobile phone technology in patient care. *British Journal of Community Nursing, 13*(4), 160-165.

Blaya, J. A., Fraser, H. S., & Holt, B. (2010). E-health technologies show promise in developing countries. *Health affairs, 29*(2), 244-251.

Boulos, M. N., Wheeler, S., Tavares, C., & Jones, R. (2011). How smartphones are changing the face of mobile and participatory healthcare: an overview, with example from eCAALYX. *Biomedical engineering online, 10*(24), 1-14.

Bryman, A. (2012). *Social Research Methods* (Fourth ed.). New York: Oxford University Press.

Cole-Lewis, H., & Kershaw, T. (2010). Text messaging as a tool for behavior change in disease prevention and management. *Epidemiologic reviews, 32*(1), 56-69.

Coovadia, H., Jewkes, R., Barron, P., Sanders, D., & McIntyre, D. (2009). The health and health system of South Africa: historical roots of current public health challenges. *The Lancet, 374*(9692), 817-834.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (Fourth ed.). London: Sage Publications.

Davey, S., & Davey, A. (2014). Mobile-health technology: can it strengthen and improve public health systems of other developing countries as per Indian strategies? A systematic review of the literature. *International Journal of Medicine and Public Health, 4*(1), 40-45.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management science, 35*(8), 982-1003.

Day, C., Groenewald, P., Laubscher, R., van Schaik, N., & Bradshaw, D. (2014). Monitoring of non-communicable diseases such as hypertension in South Africa: challenges for the post-2015 global development agenda. *South African Medical Journal, 104*(10), 680-687.

Fjeldsoe, B. S., Marshall, A. L., & Miller, Y. D. (2009). Behavior change interventions delivered by mobile telephone short-message service. *American journal of preventive medicine, 36*(2), 165-173.

Free, C., Phillips, G., Galli, L., Watson, L., Felix, L., Edwards, P., . . . Haines, A. (2013a). The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: a systematic review. *PLoS medicine, 10*(1), 1-45.

Free, C., Phillips, G., Watson, L., Galli, L., Felix, L., Edwards, P., . . . Haines, A. (2013b). The effectiveness of mobile-health technologies to improve health care service delivery processes: a systematic review and meta-analysis. *PLoS medicine, 10*(1), 1-26.

Green, D. A. (2005, 6 - 8 April). *Realtime Compliance Management Using a Wireless Realtime Pillbottle: A Report on the Pilot Study of SIMPILL.* Paper presented at the Med-e-Tel 2005 Conference, Luxembourg.

Groupe Speciale Mobile Association. (2015). *The Mobile Economy Sub-Saharan Africa 2015*. Retrieved from http://www.gsmamobileeconomy.com/

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (Sixth ed.). New Jersey: Pearson Prentice Hall.

Harris, B., Goudge, J., Ataguba, J. E., McIntyre, D., Nxumalo, N., Jikwana, S., & Chersich, M. (2011). Inequities in access to health care in South Africa. *Journal of public health policy, 32*(1), 102-123.

Holden, R. J., & Karsh, B.-T. (2010). The technology acceptance model: its past and its future in health care. *Journal of biomedical informatics, 43*(1), 159-172.

Istepanaian, R. S., & Lacal, J. C. (2003, 17 - 23 September). *Emerging mobile communication technologies for health: some imperative notes on m-health.* Paper presented at the 25th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Cancun, Mexico.

Istepanian, R. S., Laxminarayan, S., & Pattichis, C. S. (2006). *M-Health: Emerging Mobile Health Systems* (First ed.). Boston: Springer.

Kahn, J. G., Yang, J. S., & Kahn, J. S. (2010). 'Mobile' health needs and opportunities in developing countries. *Health affairs, 29*(2), 252-258.

Källander, K., Tibenderana, J. K., Akpogheneta, O. J., Strachan, D. L., Hill, Z., ten Asbroek, A. H., . . . Meek, S. R. (2013). Mobile health (mHealth) approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: a review. *Journal of medical Internet research, 15*(1), 1-13.

Kaplan, W. A. (2006). Can the ubiquitous power of mobile phones be used to improve health outcomes in developing countries? *Globalization and health, 2*(9), 1-14.

Kim, D., & Chang, H. (2007). Key functional characteristics in designing and operating health information websites for user satisfaction: an application of the extended technology acceptance model. *International journal of medical informatics, 76*(11), 790-800.

Klasnja, P., & Pratt, W. (2012). Healthcare in the pocket: mapping the space of mobile-phone health interventions. *Journal of biomedical informatics, 45*(1), 184-198.

Krishna, S., Boren, S. A., & Balas, E. A. (2009). Healthcare via cell phones: a systematic review. *Telemedicine and e-Health, 15*(3), 231-240.

Kumar, S., Nilsen, W. J., Abernethy, A., Atienza, A., Patrick, K., Pavel, M., . . . Spruijt-Metz, D. (2013). Mobile health technology evaluation: the mHealth evidence workshop. *American journal of preventive medicine, 45*(2), 228-236.

Lee, G. J. (2015). *Business Statistics Made Easy in SAS*. Johannesburg: Silk Route Press.

Lewis, T., Synowiec, C., Lagomarsino, G., & Schweitzer, J. (2012). E-health in low- and middle-income countries: findings from the Center for Health Market Innovations. *Bulletin of the World Health Organization, 90*(5), 332-340.

Mathieson, K. (1991). Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research, 2*(3), 173-191.

Mayosi, B. M., Flisher, A. J., Lalloo, U. G., Sitas, F., Tollman, S. M., & Bradshaw, D. (2009). The burden of non-communicable diseases in South Africa. *The Lancet, 374*(9693), 934-947.

Mechael, P. N. (2009). The case for mHealth in developing countries. *innovations, 4*(1), 103-118.

Meier, C. A., Fitzgerald, M. C., & Smith, J. M. (2013). Ehealth: extending, enhancing, and evolving health care. *Annual review of biomedical engineering, 15*(1), 359-382.

Phaswana-Mafuya, N., Peltzer, K., Chirinda, W., Musekiwa, A., & Kose, Z. (2013). Sociodemographic predictors of multiple non-communicable disease risk factors among older adults in South Africa. *Global health action, 6*(1), 20680-20687.

PricewaterhouseCoopers Health Research Institute. (2014). *Healthcare delivery of the future: How digital technology can bridge time and distance between clinicians and consumers*. Retrieved from http://www.pwc.com/us/en/health-industries/top-health-industry-issues/healthcare-technology-and-innovation.html

Rice, R. E., & Katz, J. E. (2003). Comparing internet and mobile phone usage: digital divides of usage, adoption, and dropouts. *Telecommunications Policy, 27*(8), 597-623.

Sarker, S., & Wells, J. D. (2003). Understanding mobile handheld device use and adoption. *Communications of the ACM, 46*(12), 35-40.

Sarwar, M., & Soomro, T. R. (2013). Impact of smartphone's on society. *European Journal of Scientific Research, 98*(2), 216-226.

Silva, B. M., Rodrigues, J. J., de la Torre Díez, I., López-Coronado, M., & Saleem, K. (2015). Mobile-health: a review of current state in 2015. *Journal of biomedical informatics, 56*(6), 265-272.

Statistics South Africa. (2014b). *Mortality and Causes of Death in South Africa, 2013: Findings from Death Notification*. Retrieved from http://www.statssa.gov.za/

Statistics South Africa. (2015). *General Household Survey 2014*. Retrieved from http://www.statssa.gov.za/

Sun, Y., Wang, N., Guo, X., & Peng, Z. (2013). Understanding the acceptance of mobile health services: a comparison and integration of alternative models. *Journal of Electronic Commerce Research, 14*(2), 183-201.

Tomlinson, M., Rotheram-Borus, M. J., Swartz, L., & Tsai, A. C. (2013). Scaling up mHealth: where is the evidence? *PLoS medicine, 10*(2), 1382-1387.

West, D. M. (2012). How mobile devices are transforming healthcare. *Issues in technology innovation, 18*(1), 1-11.

Williams, B., Brown, T., & Onsman, A. (2012). Exploratory factor analysis: a five-step guide for novices. *Australasian Journal of Paramedicine, 8*(3), 1-13.

Wilson, E. V., & Lankton, N. K. (2004). Modeling patients' acceptance of provider-delivered E-health. *Journal of the American Medical Informatics Association, 11*(4), 241-248.

World Bank. (2016). *The little data book on Information and Communication Technology 2015*. Retrieved from http://data.worldbank.org/products/data-books/little-data-book-on-info-communication-tech

Wu, J.-H., Wang, S.-C., & Lin, L.-M. (2007). Mobile computing acceptance factors in the healthcare industry: a structural equation model. *International journal of medical informatics, 76*(1), 66-77.

APPENDIX A: RESEARCH INSTRUMENT

Appendix A1: Letter to survey respondents

Dear Respondent

Thank you for taking the time to complete this survey. The purpose of this Master's research is to establish the factors that may influence a person's willingness to adopt mobile health services to track and manage their health status.

mHealth and Mobile Health Services refer to healthcare services delivered and accessed through mobile technology devices such as smartphones, tablets and personal computers.

This survey will take no more than 10 minutes to complete. Kindly note that you are under no obligation to complete this survey, there is no incentive, monetary or otherwise, that will be offered to complete the survey. Your personal details are also not required in the survey.

Please be assured that your responses will be kept strictly confidential.

By proceeding with this survey you will be deemed to have given your informed consent to participate. Please click on the "start" button to proceed.

Link to survey: https://wits.eu.qualtrics.com/SE/?SID=SV_0un7H2dJySDyk1T

Regards,

Katleho Mosehle

Master's candidate

Contact number: 073 336 4884

Email address: Mosehle@yahoo.com

Research supervisor's contact details:

Dr Yvonne Saini

Contact number: 011 717 3586

Email address: Yvonne.Saini@wits.ac.za

Appendix A2: Research Instrument

1. Please select the age group that you fall under:
   - ○ Below 20
   - ○ 20 - 29
   - ○ 30 - 39
   - ○ 40 - 49
   - ○ 50 - 59
   - ○ Above 60

2. Please select your gender:
   - ○ Female
   - ○ Male

3. Have you been diagnosed with a chronic illness such as Diabetes, Hypertension (high blood pressure), Hyperlipidaemia (high cholesterol) or heart related chronic diseases?
   - ○ Yes
   - ○ No

4. Do you have a family history of chronic illnesses such as Diabetes, Hypertension (high blood pressure), Hyperlipidaemia (high cholesterol) or heart related chronic diseases?
   - ○ Yes
   - ○ No

Respondents were allowed to select only one answer option for questions 1 to 4.

5. Please select which of the following devices you use (select all that apply):

- ☐ Smart phone
- ☐ Tablet
- ☐ Laptop
- ☐ Personal computer
- ☐ Fitness/Health tracker e.g. Fitbit, Garmin, Samsung watch or Apple watch
- ☐ None of the above

Respondents were allowed to select more than one answer option for question 5.

6. Have you heard of mobile healthcare (mHealth), Mobile Health Services, Telehealth, eHealth, electronic health records and/or electronic medical records?

- ○ Yes
- ○ No

7. Please rate how likely you are to use an mHealth app or mobile health service within the next 12 months? The rating scale is 0 -10, 0 = "Extremely **unlikely to use** an mHealth app or mobile health service within the next 12 months", 10 = "Extremely likely **to use** an mHealth app or mobile health service within the next 12 months".

Extremely unlikely to use										Extremely likely to use
0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

Respondents were allowed to select only one answer option for questions 6 and 7.

8. How likely are you to use one of the following mHealth solutions to track or manage your chronic illness or to manage your overall health?

	Extremely unlikely	Unlikely	Neither likely nor unlikely	Likely	Extremely likely
Medication reminder services	○	○	○	○	○
Health tracking tools e.g. step counters, weight tracker	○	○	○	○	○
Remote consultation	○	○	○	○	○
Fitness and health management apps (including electronic health/medical records)	○	○	○	○	○
General fitness, health and medical education tools	○	○	○	○	○

Respondents were allowed to select only one answer option for each statement.

9. Please rate how likely it is that the following will be a barrier to the uptake of mHealth:

	Extremely unlikely	Unlikely	Neither likely nor unlikely	Likely	Extremely likely
Affordability of mobile network services e.g. data, airtime	○	○	○	○	○
Patient's discomfort with changes to healthcare regimen	○	○	○	○	○
Resistance from healthcare providers, medical aid schemes and health insurers	○	○	○	○	○
Lack of minimum standards and regulation slowing the pace of innovation	○	○	○	○	○
Affordability of smart devices e.g. smart phones, tablets	○	○	○	○	○

Respondents were allowed to select only one answer option for each statement.

10. Please rate how likely it is for patients suffering from chronic illnesses and high risk individuals, to gain the following benefits from mHealth or mobile health services:

	Extremely unlikely	Unlikely	Neither likely nor unlikely	Likely	Extremely likely
Greater access to health services and treatment	○	○	○	○	○
Improved interactions between healthcare providers and patients	○	○	○	○	○
Increased adherence to disease management/treatment plan	○	○	○	○	○
Increased efficiency in the delivery of health services at primary healthcare provider i.e. doctor or clinic	○	○	○	○	○
Reduction in cost of healthcare services	○	○	○	○	○

Respondents were allowed to select only one answer option for each statement.

11. Please indicate how strongly you agree or disagree with each of the following statements

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Privacy and confidentiality are important to me	○	○	○	○	○
I care about the quality of care I receive	○	○	○	○	○
I want to be involved in the healthcare decisions being taken about my health	○	○	○	○	○
I want to improve the communication between myself and my healthcare provider	○	○	○	○	○
Convenience, the ease with which I access healthcare services is important to me	○	○	○	○	○

Respondents were allowed to select only one answer option for each statement.

12. Please indicate how strongly you agree or disagree with each of the following statements:

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Mobile health services will make it more convenient for me to access a healthcare provider and health services	○	○	○	○	○
Mobile health services will make it easier to access to health or medical related information	○	○	○	○	○
Mobile technology will empower me to track and manage my health at my own pace and in my own time	○	○	○	○	○
Mobile health services may lead to a reduction in healthcare costs	○	○	○	○	○
Mobile technology may increase the level of quality of the care I receive	○	○	○	○	○

Respondents were allowed to select only one answer option for each statement.

13. Please indicate how strongly you agree or disagree with each of the following statements:

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	○	○	○	○	○
mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	○	○	○	○	○
mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	○	○	○	○	○
Mobile health solutions will enable me to be more involved in the management of my health status	○	○	○	○	○
Mobile health services will improve the relationship I have with primary healthcare provider	○	○	○	○	○

Respondents were allowed to select only one answer option for each statement.

APPENDIX B: DESCRIPTIVE STATISTICS

Appendix B1: Hypothesis testing

Heard_of_mHealth	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
1		6.1782	5.5824	6.7740	3.0179	2.6514	3.5030
2		5.1081	4.3387	5.8775	3.3210	2.8588	3.9630
Diff (1-2)	**Pooled**	1.0701	0.1189	2.0213	3.1494	2.8496	3.5202
Diff (1-2)	**Satterthwaite**	1.0701	0.1036	2.0366			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	173	2.22	0.0277
Satterthwaite	Unequal	148.4	2.19	0.0302

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	714.66601	357.33300	59.22	<.0001
Error	171	1031.79376	6.03388		
Corrected Total	173	1746.45977			

Appendix B2: Mean and standard deviation

Research item	N	Mean	SD
Medication reminder services	174	-0.0194	1.26
I care about the quality of care I receive	174	0.0333	1.18
I want to be involved in the healthcare decisions being taken about my health	174	-0.0481	0.96
I want to improve the communication between myself and my healthcare provider	174	0.0125	1.12
Convenience, the ease with which I access healthcare services is important to me	174	0.0326	1.07
Mobile health services will make it more convenient for me to access a healthcare provider and health services	174	-0.0195	1.13
Mobile health services will make it easier to access to health or medical related information	174	-0.0632	0.84
Mobile technology will empower me to track and manage my health at my own pace and in my own time	174	-0.0211	0.82
Mobile health services may lead to a reduction in healthcare costs	174	-0.0263	0.81
Mobile technology may increase the level of quality of the care I receive	174	-0.0472	1.01
mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	174	0.0439	0.77
mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	174	0.0508	0.75
mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	174	0.0464	0.75
Mobile health solutions will enable me to be more involved in the management of my health status	174	0.038	0.79
Mobile health services will improve the relationship I have with primary healthcare provider	174	0.0254	0.92
Privacy and confidentiality are important to me	174	0.3716	0.89

Research item	N	Mean	SD
I care about the quality of care I receive	174	0.6695	1.05
I want to be involved in the healthcare decisions being taken about my health	174	0.5028	1.12
I want to improve the communication between myself and my healthcare provider	174	0.2458	0.9
Convenience, the ease with which I access healthcare services is important to me	174	0.4992	1.08
Mobile health services will make it more convenient for me to access a healthcare provider and health services	174	-0.2516	0.69
Mobile health services will make it easier to access to health or medical related information	174	-0.1417	0.64
Mobile technology will empower me to track and manage my health at my own pace and in my own time	174	-0.0997	0.71
Mobile health services may lead to a reduction in healthcare costs	174	-0.3192	0.88
Mobile technology may increase the level of quality of the care I receive	174	-0.3131	0.8
mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	174	-0.2407	0.69
mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	174	-0.275	0.79
mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	174	-0.318	0.71
Mobile health solutions will enable me to be more involved in the management of my health status	174	-0.1744	0.65
Mobile health services will improve the relationship I have with primary healthcare provider	174	-0.3299	0.77

APPENDIX C: FACTOR ANALYSIS

Rotated Factor Pattern	Factor1	Factor2	Factor3	Factor4	Factor5
Medication reminder services	0.2762	0.20392	0.57589	0.08193	0.17343
Health tracking tools e.g. step counters, weight tracker	0.19889	0.11249	0.70458	0.16417	0.08778
Remote consultation	0.30911	0.21565	0.61993	0.00852	0.0801
Fitness and health management apps (including electronic health/medical records)	0.25953	0.08427	0.80248	0.12536	-0.00632
General fitness, health and medical education tools	0.30698	0.09466	0.79751	0.13299	-0.03455
Affordability of mobile network services e.g. data, airtime	0.04805	-0.0361	0.02144	0.02944	0.71215
Patient's discomfort with changes to healthcare regimen	0.02958	0.03906	-0.04577	-0.05493	0.67324
Resistance from healthcare providers, medical aid schemes and health insurers	0.02523	0.08261	0.16341	0.08598	0.57085
Lack of minimum standards and regulation slowing the pace of innovation	-0.01154	0.02224	0.11981	0.14866	0.57306
Affordability of smart devices e.g. smartphones , tablets	0.09596	-0.0857	-0.08271	0.05761	0.76999
Greater access to health services and treatment	0.19508	0.7596	0.20138	0.0367	-0.03757
Improved interactions between healthcare providers and patients	0.26931	0.81298	0.05291	0.03677	-0.0614
Increased adherence to disease management/treatment plan	0.21392	0.78654	0.19002	-0.00342	0.04483
Increased efficiency in the delivery of health services at primary healthcare provider i.e. doctor or clinic	0.30543	0.80385	0.10273	0.02016	0.02476
Reduction in cost of healthcare services	0.40685	0.59731	0.12433	0.04285	0.10828
Privacy and confidentiality are important to me	0.0174	-0.05112	-0.04191	0.7045	0.05623
I care about the quality of care I receive	0.02955	0.01259	0.02938	0.77332	0.03854
I want to be involved in the healthcare decisions being taken about my health	0.13007	-0.03217	0.12932	0.70079	0.08397
I want to improve the communication between myself and my healthcare provider	0.20908	0.08589	0.17013	0.67087	0.05321
Convenience, the ease with which I access healthcare services is important to me	0.16399	0.11928	0.18306	0.69937	0.06302

Rotated Factor Pattern	Factor1	Factor2	Factor3	Factor4	Factor5
Mobile health services will make it more convenient for me to access a healthcare provider and health services	0.69603	0.18491	0.2104	0.08961	0.04693
Mobile health services will make it easier to access to health or medical related information	0.62086	0.20679	0.22995	0.29284	-0.00755
Mobile technology will empower me to track and manage my health at my own pace and in my own time	0.69236	0.15103	0.3809	0.21743	-0.05077
Mobile health services may lead to a reduction in healthcare costs	0.71744	0.19616	0.17222	0.11864	-0.01019
Mobile technology may increase the level of quality of the care I receive	0.81145	0.20374	0.0383	0.11895	0.00644
mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	0.79735	0.2345	0.21852	0.04518	0.05645
mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	0.7384	0.15095	0.23201	0.08501	0.13836
mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	0.80977	0.13652	0.09283	0.01149	0.15846
Mobile health solutions will enable me to be more involved in the management of my health status	0.74733	0.17679	0.38938	0.08407	-0.03638
Mobile health services will improve the relationship I have with primary healthcare provider	0.75394	0.2311	0.2035	0.05548	0.02722

APPENDIX D: REGRESSION ANALYSIS

Root MSE	2.45640
Dependent Mean	5.70115
R-Square	0.4092
Adj R-Sq	0.4023
AIC	491.71979
AICC	491.95648
SBC	325.19695

Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	5.701149	0.186219	30.62	<.0001
Factor1	1	1.327715	0.193256	6.87	<.0001
Factor3	1	1.625290	0.199288	8.16	<.0001

APPENDIX E: GAUSSIAN DISTRIBUTION FIT

Appendix E1: Gaussian distribution fit

	Medication reminder services	I care about the quality of care I receive	I want to be involved in the healthcare decisions being taken about my health	I want to improve the communication between myself and my healthcare provider	Convenience, the ease with which I access healthcare services is important to me	Mobile health services will make it more convenient for me to access a healthcare provider and health services	Mobile health services will make it easier to access to health or medical related information	Mobile technology will empower me to track and manage my health at my own pace and in my own time	Mobile health services may lead to a reduction in healthcare costs	Mobile technology may increase the level of quality of the care I receive	mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	mHealth ɔlutions and ervices will have a positive impact on ıe quality of healthcare services I receive	Mobile health solutions will enable me to be more involved in the management of my health status	Mobile health services will improve the relationship I have with primary healthcare provider	**Overall**
Observed frequencies																
1	32	16	27	20	15	22	21	11	12	25	3	2	3	4	6	**219**
2	18	19	24	15	11	36	44	26	26	39	11	11	9	8	18	**315**
3	22	16	45	21	19	16	44	45	48	26	21	15	19	30	33	**420**
4	62	65	54	71	75	60	48	65	63	58	88	92	92	82	67	**1042**
5	40	58	24	47	54	40	17	27	25	26	51	54	51	50	50	**614**
n =	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	**2610**
Distribution parameters																
μ =	**-0.14**	**0.25**	**-0.36**	**0.09**	**0.24**	**-0.14**	**-0.47**	**-0.16**	**-0.19**	**-0.35**	**0.32**	**0.37**	**0.34**	**0.28**	**0.19**	
σ^2 =	**1.58**	**1.38**	**0.93**	**1.25**	**1.14**	**1.29**	**0.71**	**0.68**	**0.66**	**1.03**	**0.60**	**0.56**	**0.56**	**0.63**	**0.84**	
σ =	**1.26**	**1.18**	**0.96**	**1.12**	**1.07**	**1.13**	**0.84**	**0.82**	**0.81**	**1.01**	**0.77**	**0.75**	**0.75**	**0.79**	**0.92**	
Expected																

frequencies															
1	28.8	14.8	25.7	16.7	11.5	24.5	25.0	12.4	13.1	27.4	2.5	1.8	2.0	3.3	7.8
2	24.4	18.4	31.6	21.0	17.9	25.4	36.7	26.5	27.8	30.7	10.8	8.9	9.7	12.4	17.4
3	25.7	23.2	34.4	25.9	24.4	28.1	39.7	36.7	37.9	32.8	23.9	21.9	23.1	25.3	27.1
4	53.0	58.7	59.9	61.2	64.4	57.8	59.2	74.0	73.2	58.3	85.2	86.7	87.1	83.8	73.9
5	42.2	58.9	22.5	49.1	55.9	38.1	13.5	24.4	22.1	24.7	51.7	54.8	52.2	49.2	47.8

"Solver" parameters	τ_1	τ_2	τ_3	τ_4											
Thresholds	-1.37	-0.78	-0.29	0.74											
Means	-0.0194	0.0333	-0.0481	0.0125	0.0326	-0.0195	-0.0632	-0.0211	-0.0263	-0.0472	0.0439	0.0508	0.0464	0.0380	0.0254
Variances	0.0291	0.0254	0.0171	0.0229	0.0208	0.0237	0.0131	0.0125	0.0122	0.0188	0.0110	0.0103	0.0103	0.0115	0.0154

Sample size, n = 174 To prevent division by zero: 0

Hypothesis tests															
t-value	**-1.50**	**2.76**	**-4.86**	**1.09**	**2.98**	**-1.67**	**-7.28**	**-2.48**	**-3.14**	**-4.54**	**5.52**	**6.60**	**6.01**	**4.66**	**2.71**
p-value	**0.1354**	**0.0065**	**0.0000**	**0.2792**	**0.0033**	**0.0967**	**0.0000**	**0.0139**	**0.0020**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0075**
	Medication reminder services	I care about the quality of care I receive	I want to be involved in the healthcare decisions being taken about my health	I want to improve the communication between myself and my healthcare provider	Convenience, the ease with which I access healthcare services is important to me	Mobile health services will make it more convenient for me to access a healthcare provider and health services	Mobile health services will make it easier to access to health or medical related information	Mobile technology will empower me to track and manage my health at my own pace and in my own time	Mobile health services may lead to a reduction in healthcare costs	Mobile technology may increase the level of quality of the care I receive	mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	Mobile health solutions will enable me to be more involved in the management of my health status	Mobile health services will improve the relationship I have with primary healthcare provider

Appendix E2: Gaussian distribution fit (2)

	Privacy and confidentiality are important to me	I care about the quality of care I receive	I want to be involved in the healthcare decisions being taken about my health	I want to improve the communication between myself and my healthcare provider	Convenience, the ease with which I access healthcare services is important to me	Mobile health services will make it more convenient for me to access a healthcare provider and health services	Mobile health services will make it easier to access to health or medical related information	Mobile technology will empower me to track and manage my health at my own pace and in my own time	Mobile health services may lead to a reduction in healthcare costs	Mobile technology may increase the level of quality of the care I receive	mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	Mobile health solutions will enable me to be more involved in the management of my health status	Mobile health services will improve the relationship I have with primary healthcare provider	**Overall**
Observed frequencies																
1	1	1	2	2	2	5	2	2	3	3	4	4	2	1	2	**36**
2	1	0	3	1	1	4	3	5	19	14	6	15	13	8	16	**109**
3	6	2	5	8	6	29	19	20	50	51	30	34	45	20	49	**374**
4	36	23	31	46	31	88	87	75	45	53	84	69	69	86	58	**881**
5	130	148	133	117	134	48	63	72	57	53	50	52	45	59	49	**1210**
n =	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	**2610**
Distribution parameters																
μ =	**0.58**	**1.05**	**0.79**	**0.39**	**0.78**	**-0.39**	**-0.22**	**-0.16**	**-0.50**	**-0.49**	**-0.38**	**-0.43**	**-0.50**	**-0.27**	**-0.52**	
σ^2 =	**0.80**	**1.10**	**1.25**	**0.81**	**1.17**	**0.47**	**0.41**	**0.51**	**0.77**	**0.64**	**0.47**	**0.62**	**0.50**	**0.43**	**0.60**	
σ =	**0.89**	**1.05**	**1.12**	**0.90**	**1.08**	**0.69**	**0.64**	**0.71**	**0.88**	**0.80**	**0.69**	**0.79**	**0.71**	**0.65**	**0.77**	
Expected frequencies																
1	0.5	0.4	1.5	1.0	1.2	2.6	0.8	1.3	9.9	7.0	2.4	5.6	4.4	1.2	6.7	
2	1.6	1.1	2.6	2.7	2.3	8.6	4.2	4.9	14.9	13.6	8.2	11.9	11.8	5.3	13.7	

3	8.0	4.9	8.9	11.8	8.4	34.9	25.1	23.9	37.0	38.2	34.1	36.2	40.0	28.1	39.7
4	34.1	20.7	28.4	41.9	28.4	77.7	79.4	71.0	62.0	67.5	77.7	68.9	75.1	79.7	69.3
5	129.9	146.8	132.6	116.6	133.7	50.1	64.4	72.8	50.1	47.6	51.6	51.5	42.7	59.7	44.6

"Solver" parameters	τ_1	τ_2	τ_3	τ_4											
Thresholds	-1.89	-1.44	-0.83	-0.01											
Means	0.3716	0.6695	0.5028	0.2458	0.4992	-0.2516	-0.1417	-0.0997	-0.3192	-0.3131	-0.2407	-0.2750	-0.3180	-0.1744	-0.3299
Variances	0.3252	0.4472	0.5102	0.3277	0.4748	0.1922	0.1672	0.2058	0.3129	0.2602	0.1916	0.2510	0.2050	0.1731	0.2442

Sample size, n = 174 To prevent division by zero: 0

Hypothesis tests															
t-value	**8.60**	**13.21**	**9.28**	**5.66**	**9.56**	**-7.57**	**-4.57**	**-2.90**	**-7.53**	**-8.10**	**-7.25**	**-7.24**	**-9.27**	**-5.53**	**-8.81**
p-value	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0042**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
	Privacy and confidentiality are important to me	I care about the quality of care I receive	I want to be involved in the healthcare decisions being taken about my health	I want to improve the communication between myself and my healthcare provider	Convenience, the ease with which I access healthcare services is important to me	Mobile health services will make it more convenient for me to access a healthcare provider and health services	Mobile health services will make it easier to access to health or medical related information	Mobile technology will empower me to track and manage my health at my own pace and in my own time	Mobile health services may lead to a reduction in healthcare costs	Mobile technology may increase the level of quality of the care I receive	mHealth solutions and services will make the provision of healthcare more convenient and accessible for me	mHealth solutions and services will reduce my overall healthcare costs e.g. traveling to the doctor or clinic, time taken off work	mHealth solutions and services will have a positive impact on the quality of healthcare services I receive	Mobile health solutions will enable me to be more involved in the management of my health status	Mobile health services will improve the relationship I have with primary healthcare provider