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Factors Influencing the Adoption of Mobile Health Monitoring and Care Systems by the Elderly Living at Home in South Africa: A Case of Buffalo City Metropolitan Municipality

by

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by

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(201414065)

Dissertation

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Abstract

The gradual increase of elderly people around the globe necessitates intensive dialogue amongst government, the healthcare sector and elderly communities as per MPAA 2002 resolutions. Literature identifies technology as the enabler to drive the facilitation of improved living conditions beginning with an affordable, accessible and integrated health information system (HIS). The attainment of a better quality of care to meet the elderly's needs requires the re-engineering of current modalities. The diverse nature of South Africa is more suited to a people-based rather than a process-centric approach currently in existence. Access barriers, affordability, the digital divide, lack of government buy-in, and fragmented HIS are considered major impediments to adoption of mobile monitoring and care systems (MMCs) for the elderly's healthcare. Given the complications brought about by the Covid-19 pandemic, the adoption of MMCs cannot be more pronounced. However, despite available literature regarding elderly issues in both developed and developing countries, the elderly plight has still not been considered a national priority.

The main purpose of this research was to investigate why elderly people do not adopt MMCs to improve their quality of life, with MMC technologies as a general area of research. The main objective of the study was to develop critical success factors to improve the adoption of MMCs by the elderly living at home. This would potentially alleviate the burden on healthcare resources and also improve the elderly's quality of life.

Primary data collection took place from 21 February to 28 February 2020 in Buffalo City Metropolitan Municipality. Semi-structured interviews were conducted with 15 participants comprising one male and 14 females who represented the elderly Black, Coloured, Indian and White people. This qualitative research tool and purposive sampling method were chosen in order to fully capture the participants' experiences in the home environment, which excluded those living in frail care or step-down facilities or state institutions. Despite the sample size being small and not being generalizable, it delivered rich information which provided a deeper understanding and fresh insights into the landscape of the elderly and their healthcare needs. The interviews were recorded, transcribed and analysed thematically.

The study found that elderly communities are not entirely averse to adoption of MMCs but challenges like affordability and chronic shortage of technical skills prove to be impediments

to adoption of MMCs for the elderly's healthcare. The lack of standardisation and data governance pertaining to data sharing in HISs also serve to exacerbate the matter.

The study, therefore, recommends collaborative engagements amongst government, business and the elderly to facilitate the availability of affordable and accessible ICT infrastructure for the elderly communities. Improved adoption of MMCs carry the potential benefit which emanates from the assumption of a pro-active role by the elderly and optimising available MMCs thus reducing strain and freeing-up healthcare workers to concentrate on core duties. The onus thus falls on the healthcare sector to revise the available strategies which seek to enhance the quality of life of the elderly people living in the home environment.

Declaration

I, **Yolande Odwa Fotoyi**, hereby declare that:

- The work in this dissertation is my own work.
- All sources used or referred to have been documented and recognised.
- This dissertation has not previously been submitted in full or partial fulfilment of the requirements for an equivalent or higher qualification at any other recognised institution.

Signature: _  _____

Date: 14 January 2021

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All thanks also go to my peers for the exchange of ideas, especially to Bulelani Ngamntwini. To GOD be the Glory!

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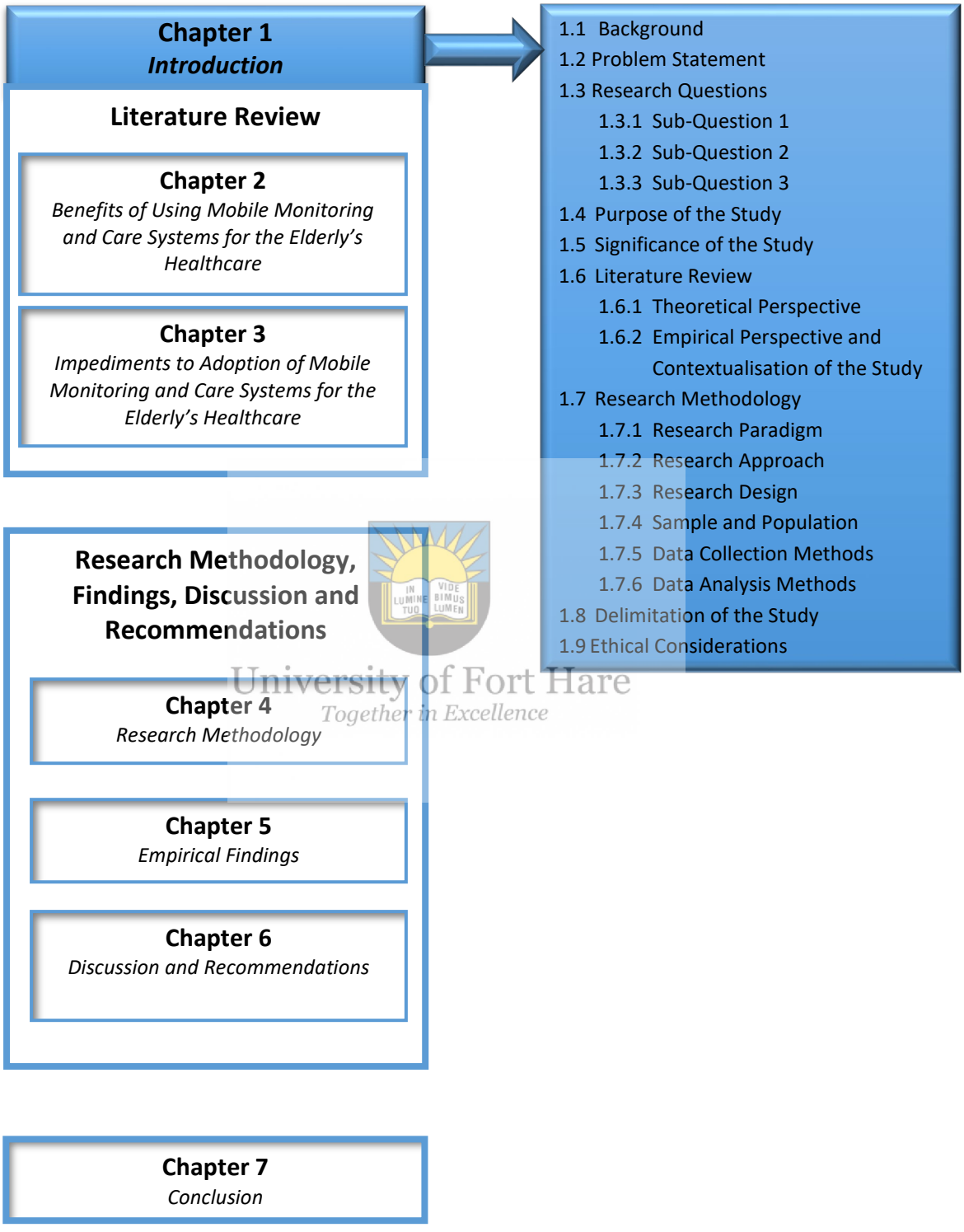
Acronyms

Acronym	Description
AAL	Ambient Assisted Living
ADM	Amathole District Municipality
AI	Artificial Intelligence
AT&T	American Telephone & Telegram
AU	African Union
AUPFAA	African Union Policy Framework on Plan of Action on Ageing
BCMM	Buffalo City Metropolitan Municipality
BRICS	Brazil, Russia, India, China, and South Africa
BP	Blood Pressure
BT	Body Temperature
CSFs	Critical Success Factors
DoJCD	Department of Justice and Constitutional Development
DGF	Data Governance Framework
DSD	Department of Social Development
EC	Eastern Cape
EHC	Elderly Health Care

EHEALTH	Electronic Health
GPS	Global Positioning Service
HIS	Health Information Systems
HABITAT	Home Assistance Based on the Internet of Things for the Autonomy of Everybody
HIPPA	Health Insurance Portability and Accountability Act
HR	Heartbeat Rate
HIV	Human Immunodeficiency Virus
ICT	Information Communications Technology
IoT	Internet of Things
IHIS	Integrated Health Information Systems
KORA	Danish Institute for Local and Regional Government Research
KWT	King Williams Town
MPAA	Madrid Plan of Action on Aging
MMCs	Mobile Monitoring and Care systems
MYPE	Mid-Year Population Estimate
MHEALTH	Mobile Health
MHLW	Ministry of Health, Labour and Welfare
NGO	Non-Governmental Organisation

NCPF	National Cybersecurity Policy Framework
NIA	National Institute on Aging
OAHs	Old Age Homes
PoPI Act	Protection of Personal Information Act
PAIA	Promotion of Access to Information Act
PHI	Personal Health Information
POCUS	Point of care ultra sound
RFID	Radio Frequency identification
STS theory	Socio-Technical Systems theory
SA	South Africa
SDG	Sustainable Development Goals
SAHRC	South African Human Rights Council
TAFTA	The Association For The Aged
TLC	Transitional Local Council
UREC	Research Ethics Committee of the University of Fort Hare
UNESCO	United Nations Educational Scientific and Cultural Organisation
VIVE	Danish Center for Social Science Research
WHO	World Health Organisation
WSN	Wireless Sensor Network

CHAPTER 1: INTRODUCTION



1.1 Background

South Africa has a population of approximately 4.6 million elderly people (Lehohla, 2019). The elderly population is estimated to grow by 8.1% per annum (Lehohla, 2019). Elderly people are considered to be all individuals who have reached the chronological age of 60 and above (Ferreira, 2019). The largest percentage of elderly people in South Africa is located in the Eastern Cape, which is also one of the poorest provinces in the country. There are an estimated 12% of the older community living in the Eastern Cape, followed by Gauteng with 7.7 % and Mpumalanga, with 7% of the older community (Lehohla, 2019).

Farrell (2019) has found that most elderly people in South Africa would prefer living in institutionalised care, but the prevailing socio-economic situation in the country prevents the elderly from accessing old age homes (OAHs). The World Health Organisation (WHO) states that, while the number of elderly people is rising globally, developing countries still experience a chronic shortage of infrastructure to house the elderly community. In 1997, only 612 OAHs were available in South Africa (Perrold & Muller, 2000). Currently there are about 1600 OAHs in South Africa, which means that only a few elderly people can be accommodated (Lehohla, 2019). As a result, about 74% of the elderly population in South Africa lives at home, either alone or with family (Farrell, 2019).

While social cohesion is encouraged when the elderly folk live at home, there is a big burden on the family to provide resources for the care of the elderly, especially for healthcare (Nikou, 2015). For instance, an elderly person that suffers from a cognitive related condition, like Alzheimer's, requires constant monitoring (Ohtu, Nakamoto, Shinagawa & Tanikawa, 2002). This means that the family must either pay a caregiver to look after the person or else a family member, who could be earning an income, must stay at home to look after the person. A third option in areas where there is a significant need for monitoring and care of the elderly is to provide unregistered housing without proper regulation by external service providers (Ferreira, 2017). This practice is prevalent in areas where OAHs are virtually non-existent, like Mpumalanga and the Northern Cape.

The rising costs of healthcare are also a cause for concern for elderly people as most do not have medical aid and rely on state resources for their healthcare (West, 2015). According to StatsSA (2019), only 22,9% of the elderly in South Africa were members of medical aid schemes in 2015. The three health conditions most common amongst the elderly persons were high blood pressure (45,3%), diabetes (15,8%) and arthritis (13,8%). These chronic illnesses

add strain on the already overburdened resources of a country, which does not have a plan in place for longevity (Lehohla, 2019). The ubiquitous nature of technology has afforded the elderly, especially those living in rural and remote areas, an opportunity for monitoring and care inside their homes. Mobile monitoring and care (MMC) systems and sensor devices can be used to monitor the elderly in their home environment (Kudzai & Cilliers, 2016). However, different cost factors prevent elderly people from accessing technologies which can benefit and improve their quality of life.

The interconnectivity of MMC systems can assist the elderly and their caregivers to provide healthcare in their home. This means the elderly people have access to healthcare without having to travel to a healthcare centre or spend many hours waiting to be seen by a healthcare worker. The adoption of MMC systems for the healthcare industry could improve the quality of life of the elderly living at home (Ohtu, Nakamoto, Shinagawa, & Tanikawa, 2002). The following section briefly describes the different types of devices that can be used for monitoring the elderly living at home.

The different types of MMC systems include mobile testing kits, fall detection devices, bed sensors, vital sign monitors, mobility sensors for frail care, ambient assisted living (AAL) systems to improve safety, security, health and wellness of the elderly (van Rooyen & Breetzke, 2014). Mobility is the ability of the individual to move quicker and easily (National Institute on Aging, 2020). Although there are several types of MMC systems available to alleviate the burden of care of the elderly, the technologies have not been adopted by the elderly to improve their health care (Moon & Chang, 2014). Reasons for this are that MMC systems are considered too expensive to implement by the majority of elderly people (West, 2015; van Rooyen & Breetzke, 2014; Agree & Freedman, 2011). Literature indicates that while elderly people may use technology for health purposes, they often do not trust the technology (Zeissig, Lidynia, Vervier, Gadeib and Ziefle, 2017; Kudzai & Cilliers, 2016; Gaba & Cilliers, 2014; Wilson, Hargreaves and Hauxwell-Baldwin, 2014; Balta-Ozkan, Davidson, Bicket and Whitmarsh, 2013; Morris et al., 2013). These trust issues emanate from a lack of privacy and security concerns raised by the elderly (Zeissig et al., 2017; Boucher, 2013). This study sought to understand the reasons why MMC systems are not adopted for healthcare use by the elderly in the home environment.

1.2 Problem Statement

Literature indicates that elderly people have a distrust relationship with technology (Kudzai & Cilliers, 2016; Wilson, Hargreaves and Hauxwell-Baldwin, 2014; Balta-Ozkan, Davidson, Bicket and Whitmarsh, 2013; Morris et al., 2013). Van Dijk (2009) found that there are four kinds of barriers that restrict the adoption of MMC systems for healthcare among the elderly. The first barrier relates to material access where the user does not have access to the technology. This MMC technology in South Africa, a developing country, is very expensive and is not within the financial means of the majority of the elderly (West, 2015; Adebesin, Foster, Kotze & Van Greunen, 2013). The second barrier, skills access, is linked to the lack of digital skills that prevent the user from using the technology. Often the elderly folk are technologically challenged and not able to use new technology, leading to what is termed technological anxiety (Zeissig et al., 2017; Lee, Simpson & Froggatt, 2013). The third restriction alludes to usage access wherein the user does not have the opportunity to use technology as it is not available in the home environment. Finally, mental access relates to a personal attribute where the user shows no compunction to use the technology. These restrictions raise concerns relating to affordability and access to healthcare.

As mentioned, MMC systems are considered too expensive to be used by the majority of elderly people (West, 2015). Although the benefits of using MMC systems have been identified by research, some literature argues that affordability is an impediment to the full adoption of MMC systems to alleviate the burden on healthcare resources for the elderly (Ferreira, 2017; Balta-Ozkan et al., 2013; Boroto & Quentin, 2012). Elderly people refrain from using MMC systems for healthcare for various reasons. When the elderly persons do not understand the benefit that MMC systems have to improve their healthcare, they will not make use of or invest in the technology as it is seen as a luxury (Van Dijk, 2009). The restrictions mentioned above may contribute to the lower adoption levels displayed by the elderly people who show neither desire nor willingness to adopt MMC technology for their healthcare. This study therefore investigated the factors that impede the adoption of MMC systems among the elderly to lessen the burden of healthcare in South Africa. The following research questions were formulated to better understand the problem statement.

1.3 Main Research Question

The primary research question examined in this research study was as follows:

How can the adoption of mobile monitoring and care systems for healthcare monitoring be improved among the elderly living at home in South Africa?

The advantages of adopting MMC systems for elderly health care play a pivotal role in driving the adoption of MMC systems. Despite the barriers encountered in the environment, the benefits of adopting MMC systems reportedly outweigh the challenges (West, 2015). In light of the above, the following sub-questions were developed to answer the main research question:

1.3.1 Sub-Question 1

What are the healthcare benefits of using mobile monitoring and care systems for the elderly in the home environment?

Given the longevity experienced by the elderly population, research indicates that access to health care plays a pivotal role in maintaining a healthy elderly community (Boroto & Quentin, 2012). Hence West (2015) argues that a satisfied elderly community is one that has access to health care at an affordable price. In addition, there must be human resources available to assist the elderly to ensure that they receive quality healthcare (Adibi, 2014; Varshney, 2014).

1.3.2 Sub-Question 2

What are the impediments to the adoption of mobile monitoring and care systems (MMCSs) for health care amongst the elderly in the home environment?

Privacy concerns raised by the elderly need to be taken into consideration (Avancha, Baxi & Kotz, 2012; Boucher, 2013; McCallum, 2017). Elderly people raise concerns pertaining to access, storage and retrieval of personal health information (PHI) (Zeissig et al., 2017; Kudzai & Cilliers, 2016; Boucher, 2013).

1.3.3 Sub-Question 3

What are the critical success factors (CSFs) necessary to implement mobile monitoring and care systems (MMCSs) for healthcare monitoring amongst the elderly in the home environment?

Privacy concerns raised by the elderly need to be addressed (Balta-Ozkan, Davidson, Bicket, & Whitmarsh, 2013). However, government is lagging behind in formulating regulation on issues around the elderly. Factors relating to affordability and access issues have been

identified as key players in the slow uptake of adoption of MMC systems for the elderly's healthcare.

1.4 Purpose of the Study

The aim of this study was to explore why elderly people in the home environment did not adopt available MMC systems to alleviate the strain on healthcare resources. This was done by examining the relationship in the environment between the population and the technology with the use of the socio-technical systems (STS) theory as developed by Eric Trist in 1940 as explained in his 1981 publication referred to in 1.6.1. Critical success factors were developed to improve the adoption of MMC for healthcare among the elderly in the home environment.

1.5 Significance of the Study

South Africa displays one of the most fragmented healthcare systems in the world (Adebesin, Foster, Kotze, & Van Greunen, 2013). The successful adoption of MMC systems may mean increased access to healthcare by the elderly, especially in remote and rural areas of South Africa. The increase in access to healthcare may translate to an improved healthcare system that puts the elderly at the epicentre of healthcare provision. In addition, healthcare resources which are currently over-burdened may be freed up, including human resources who would then be available to concentrate on core activities. Since the costs of healthcare include associated costs like transportation, elderly people may benefit from a better adoption of MMC systems as these costs will be reduced (Wilson et al., 2014). The elderly may also benefit from a reduction in the costs of MMC technologies. In return, there may be increased adoption from the elderly communities which would lessen the burden on the family caregivers. The impact of a successful adoption of MMC systems may encourage the elderly people to assume a more pro-active role in their healthcare from an earlier age (Ferreira, 2017; Nikou, 2015).

It, therefore, is hoped that the contribution of this study will be instrumental in creating awareness of the elderly's issues pertaining to their healthcare as well as the concerns that have been raised regarding privacy, trust and the security of MMC systems (Clarke, Furnell, & Van Solms, 2010). All of these issues can only be resolved if there is stakeholder involvement and government buy-in towards a better and improved longevity for the elderly, as per the Agenda 2063 (WHO, 2019).

1.6 Literature Review

Since this study is qualitative in nature, it will focus on the adoption concerns of elderly people as an impediment to the successful implementation of MMC systems in the home environment. As a point of departure, the benefits of using MMC systems will be discussed followed by the challenges that are identified in literature, based on the theoretical perspective of the socio-technical systems (STS) theory. The study will develop critical success factors that seek to outline how the barriers can be overcome in order to alleviate the burden of care for the elderly people.

1.6.1 Theoretical Perspective

The theoretical perspective of the study is informed by the socio-technical systems (STS) theory as developed by Eric Trist, circa 1940 (Trist, 1981). The STS theory seeks to understand human behaviour in an organisation by exploring why people behave in a certain manner and examines the existing relationship between people and technology. Recent developments of the STS theory include the environment as a factor to be considered (Mumford, 2003). This study thus makes use of the STS theory to show how the complex relationship between humans and technology can be perceived.

Other studies that have used STS theory argue that the adoption of STS approaches assists in assimilation of the systems under development (Baxter & Sommerville, 2011). The STS theory has also been effective when used in the exploration of a needs identification process whereby citizens engaged with IT professionals and service providers test and adopt eGovernment goals (Dannodaran, Nicholls, Henney, Land, & Farbey, 2019). Dwyer (2019) also advocates the use of STS theory during the design of solutions to the problems emanating from climate changes. In addition, the utility of STS theory becomes a factor to be considered in managing the impact of human interaction on the environment. The adoption of STS theory, therefore, becomes relevant and more acceptable to end-users and it has the potential to deliver a value-based system to stakeholders (Ngowi & Mvungi, 2018).

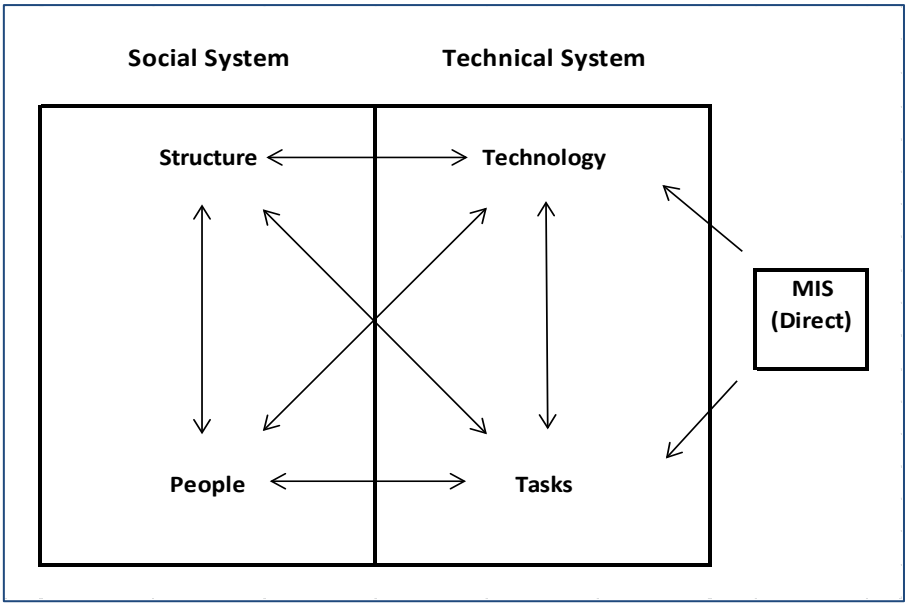


FIGURE 1: *SOCIO-TECHNICAL SYSTEMS THEORY (BOSTROM & HEINEN, 1977)*

1.6.1.1 The Socio-Technical Systems theory perspective.

The STS theory consists of two subsets, social and technical. The social subset comprises the people and structures' quadrants/ constructs. The technical subset consists of the technology and tasks' constructs (Trist, 1981). The following section discusses the constructs mentioned above.

1.6.1.2 Social subset.

The people construct will deal with the attitudes, behaviours and perceptions identified in the elderly people and how these variables affect the adoption of MMC systems. The procedures' construct discusses implementation factors preventing adoption and the reasons thereof (Ngowi & Mvungi, 2018).

1.6.1.2.1 *People construct.*

The people quadrant will inform the reader about how elderly people and healthcare workers use technology to improve the lives of the elderly living at home (Gaba & Cilliers, 2014). Mohammadzadeh and Safdari (2014) corroborate the argument above, where the opportunities of using mobile technology for healthcare will be discussed.

Privacy concerns raised by elderly people need to be addressed in the quest to include the elderly into the centre of Agenda 2063 (Lehohla, 2019). Despite the privacy paradox evident in the elderly's usage of technology, it has been established that technological devices do bring benefit to the older population (Kudzai & Cilliers, 2016; West, 2015; Van Rooyen & Breetzke,

2014). The privacy paradox can be referred to as the willingness of elderly people to share personal information for a reward, while they have concerns about how the PHI system is used, for instance, to participate in a survey for the reward whether in monetary terms or otherwise (Zeissig et al., 2017; Taddicken, 2013). The following section briefly discusses the benefits of using MMC systems.

1.6.1.2.2 *Procedure construct.*

In the procedures' construct, the reader will see how the lack of regulation effects or impacts adversely on the elderly people. This quadrant also discusses how the inadequacy of education and training levels, as well as awareness, affect the manner in which healthcare workers in the elderly arena perform their duties (Wilson et al., 2014; Boroto & Quentin, 2012).

1.6.1.3 Technical subset

The technical subset is comprised of the technology and procedures' quadrants whereby the technology that is available is explored to ascertain whether it can improve the quality of life of elderly people living at home (West, 2015). The following section provides a brief overview of what will be found in each quadrant.

1.6.1.3.1 *Technology construct.*

In the technology construct, the reader will find how the costs of technological infrastructure are an impediment to the adoption of MMC systems, like MMC and AAL, to alleviate the burden that is currently on healthcare systems for the elderly (McCallum, 2017; Charness, Dunlop, Munteanu, Nicol, Oulasvirta, Ren & Silpasuwanchai, 2016; West, 2015; van Rooyen & Breetzke, 2014). In addition, the relationship between technology and the elderly is also argued (Ngowi & Mvungi, 2018; Boucher, 2013; Baxter & Sommerville, 2011).

There needs to be a collaboration between government and business to seriously consider lowering technology costs, either through the implementation of a subsidy system for the elderly or via a sponsoring method (McCallum, 2017). Unfortunately, the infrastructure cost does not only affect the elderly living at home, but even institutions which could benefit from a lower cost of technology and healthcare (McCallum, 2017; West, 2015).

1.6.1.3.2 *Tasks construct.*

This section will explore if meaningful use of the technologies is achieved and how that reduces the burden on state resources to enhance the elderly people's quality of life (Nikou, 2015). The level of performance determines the results and this section will discuss how the healthcare workers are guided by technology to improve the quality of life of the elderly (Boucher, 2013).

1.6.2 Empirical Perspective and Contextualisation of Research

The following section seeks to provide the context of the study by defining the elderly and the instrument of technology to be discussed. This involves a brief exploration of the available MMC systems for elderly healthcare. The latter part of the section provides benefits and challenges associated with using MMC systems for elderly healthcare.

1.6.2.1 The elderly

The elderly refers to all individuals chronologically aged 60 and above (Ferreira, 2017; Ramashala, 2000). The increase in numbers of elderly people led to the development of dialogue regarding the welfare of the elderly community globally (Lehohla, P, 2019). South Africa was one of the countries that passed legislation to safeguard the interests of the elderly people, and the South African Older Persons Act 13 (2006) came into effect. One of the key objectives of the Older Persons Act 13 (2006) is to ensure that old aged people receive dignity and respect by having access to decent housing and healthcare (Statistics South Africa, 2019). The MMC systems were thus identified as the enabler in providing improved healthcare for the elderly (Kudzai & Cilliers, 2016).

Nikou (2015) states that a holistic provision of geriatric care involves both the physical and psychosocial care of elderly people. The proactive approach may result in better living conditions for the elderly communities living on their own or with family (McCallum, 2017). The deployment of smart technologies like mobile monitoring and care (MMC) systems in home environments as well as increased awareness of elderly issues through the involvement of intensive education and training campaigns could play a pivotal role in improving the quality of life of the elderly people (West, 2015; Gaba and Cilliers, 2014; van Rooyen & Breetzke, 2014).

1.6.2.2 Mobile monitoring and care systems

Mobile monitoring and care (MMC) systems refer to systems that make use of mobile devices and technology to monitor patients (Kudzai & Cilliers, 2016). There are different types of MMC systems available, for example, using smartphones over wireless body networks to monitor vital signs, bed sensors, heart rate monitors and fall detection monitors to name but a few (Peek, et al., 2016). The use of mobile technology as a biomedical imaging tool has also been identified as a monitoring tool that has potential healthcare cost reduction benefits (Litan & Song, 2008).

Vital sign monitors are mainly used to measure the vital signs like blood pressure in a patient (Mohammadzadeh & Safdari, 2014). Fall detection systems are used to detect mobility in

elderly people. A signal can be sent to the data store that will alert the caregiver of the event about to happen. The advantage of fall detectors can be seen by the rapid response rate during an emergency. Based on the architecture of the device, the emergency personnel can easily be dispatched to offer assistance, thus preventing a possible medical disaster (Mohammadzadeh & Safdari, 2014). Bed movement sensors are those devices that monitor the movement of a patient and may lead to the prevention of bed sores in frail patients. Heart rate monitors are devices like Fitbit that are used to measure the heart rate of a patient during movement.

The use of these technologies may benefit elderly people and improve their quality of life if the concerns of the elderly are addressed. These reasons prompted the proposal to include the elderly in decision-making forums (WHO, 2015). Agenda 2063 seeks to include geriatric communities in the decision-making processes. The following section will briefly discuss the benefits of using MMC systems for the elderly.

1.6.2.3 Benefits of using mobile monitoring and care systems

The benefits of using technology for the elderly's care need to be properly communicated to the elderly so that penetration, that may lead to increased adoption, can be achieved. The use of technology can benefit the elderly by bringing about cost reduction in accessing health care, an expensive exercise in the light of rising healthcare costs as the elderly community is growing exponentially (West, 2015).

The other benefit associated with using MMC systems relates to freeing up human resources to concentrate on their core functionalities (Kudzai & Cilliers, 2015; Varshney, 2014; Gaba & Cilliers, 2014). The deployment of technologies, like robotics to monitor vital signs of the infirm, increases response time in emergency situations as the healthcare workers are available to assist quickly (van Rooyen & Breetzke, 2014). Thus, the use of MMC systems in the monitoring of elderly people becomes beneficial (van Rooyen & Breetzke, 2014; Kudzai & Cilliers, 2016). Literature indicates that the benefits of using various available technologies to alleviate the burden of care of the elderly also reduces the anxiety levels that increase as a result of prolonged possible hospital stays (van Rooyen & Breetzke, 2014; Varshney, 2014; Adibi, 2014). The benefits of using technology to reduce the burden of care are there, however, privacy concerns impede the adoption of technologies to reduce the burden of care and these are discussed in the following section.

1.6.2.4 Challenges impeding the successful adoption of MMC systems for geriatric care

One of the key issues that has been raised in literature relates to access to information (Zeissig et al., 2017). Access issues that are a concern may be addressed by embarking on intensive education and training of the elderly on how the MMC systems are beneficial, as well as which methods are used to access, store and use information (McCallum, 2017). Boucher (2013) foregrounded this viewpoint before by adding that the automation of systems increases the mistrustful nature of technologies held by elderly people and resurfaces the argument about the loss of control. It is this desire to assume control of their PHI and the mistrust that is inherent in the relationship between the elderly and technologies that leads to the privacy paradox (Balla, 2017). There are four challenges identified in literature as barriers to the adoption of MMC technologies and they include the effectiveness of methods used to safeguard information, probability of occurrence of a threat, self-efficacy levels and trust in the self-efficacy levels (Zeissig et al., 2017).

1.7 Research Methodology

Research methodology refers to the technique or a specific set of procedures used by a researcher to identify, select, process and analyse information about a chosen research topic (Rajasekar, 2006). The techniques used allow the reader to make a critical evaluation of the validity and the reliability of the study. Thus, questions relating to how data was collected and analysed were answered by the research methodology section.

1.7.1 Research Paradigm

A paradigm can be said to be an overarching perspective about a particular study (Antwi & Hamza, 2015; Cohen, Manion, & Morrison, 2000). There are two commonly used paradigms, namely, positivist and interpretivist. The positivist paradigm is rooted in objectivity where facts are considered, measured and tested to produce a deductive quantifiable answer based on the facts provided. The interpretivist approach is based on human interpretation. The subjective approach of the interpretivist paradigm explores human nature and produces inductive inferences in line with how the researcher perceives the information at their disposal. Since the researcher is intimately involved in the research, the results are derived from perception, feeling and observations based on interpretation of that particular study.

This study made use of the interpretivist paradigm in order to fully explore the interpretations that were made available from data collection. The interpretivist paradigm seeks to record human behaviour and attitude, understand how meaning is derived and interpreted in the

observed environment. In this study, the researcher interviewed the elderly to understand their perspectives and reasons for why they did not adopt MMC systems to improve their health care. Therefore, the interpretivist paradigm documents social reality as a meaningful inquiry that examines the complex phenomena inherent in human understanding (Creswell, 1994).

1.7.2 Research Approach

There are three research approaches used in research, namely quantitative, qualitative and the mixed approaches. The quantitative approach uses facts as the premise of a study. The quantitative research approach is deductive in nature and measures and tests hypotheses based on the predictable behaviour presented by the data. The structured approach found in quantitative studies makes it unsuitable for this study as the aim of the study is to understand behaviour, and can thus be difficult to quantify or measure. Therefore, the statistical nature of quantitative research would not yield the expected results.

Qualitative research methodology seeks to understand the research problem by exploring the environment. The researcher is allowed to probe the situation in order to derive meaning that is later interpreted as the findings of the study. The subjective, probing nature of qualitative studies makes it more suitable for this study in order to provide the perceived interpretation from the explorative nature of the study.

In some instances, it becomes imperative to use both methods and the mixed approach may be used. Since the purpose of this study is not to measure, only the qualitative approach will be used.

1.7.3 Research Design

There are several methods of research design and they include descriptive, correlation, experimental and semi-experimental methods. These research design methods also have sub-types aligned to each of them, such as, case studies and interviews for descriptive methods. Since this study will be using interviews, the next section provides an overview of descriptive research design.

For the purpose of this study, descriptive research design was considered to be the most suitable method since the study sought to provide the analysis of a known research problem (de Vaus, 2001). Interviews were considered more appropriate for this study as human behaviour and interpretation is analysed to obtain an in-depth understanding of the environment under observation. The perceptions provided by the interviewees informed the findings of the study (Fletcher, 2018). Interviews were conducted with the research participants. The aim was to

provide a feeling of realism that was more representative of the research problem. This means the researcher aimed to take a pragmatic approach in the interpretation of the interviews. Interviews were considered to provide a contextual and therefore meaningful interpretation of reality (Gray, 2014). Several questions were formulated as a guide for the interviewees with the socio-technical systems (STS) theory perspective as the grounding framework for the study.

1.7.4 Population and Sampling

All individuals of interest to the researcher are known as the population (Marczyk, DeMatteo & Festinger, 2005). Sampling is a method whereby a subset of the population is used. Since it will be impossible to interview all the elderly people in South Africa, a sample will be chosen to represent the population of the study. Thus, if something is true about the sample, it is likely to be true about the population as well (Marczyk, DeMatteo & Festinger, 2005).

The population of this study was derived from the Buffalo City Metropolitan Municipal (BCMM) area in the Eastern Cape, a province in South Africa where the biggest population of the elderly resides (Lehohla, 2019). The sample size consisted of 15 elderly people from different socio-economic conditions and racial orientations, living in their home environments. Users of MMC systems, including the elderly who do not own mobile devices but are aware of them, were interviewed to obtain a holistic perspective of the environment under observation. These interviews were conducted in situ. Purposive sampling was chosen for its subjective nature because the researcher had decided what needed to be known. This means that the participants have been deliberately chosen for the qualities they possess and may be able to provide the information required, as advocated by Etikan, Musa and Alkasim, (2016). Participants consented to a tape recorder being used to capture the interviews as well as notes being taken that captured the pertinent details of the interviews.

1.7.5 Data Collection

Data collection is a critical step of any research study. This study makes use of primary and secondary data collection methods. Primary data collection refers to the process of gathering data at source to answer a specific research question (Hox & Boeije, 2005; Flick, 2018). The researcher did not rely on second-hand information, but made deductions based on the reaction at the time of the data collection. Secondary data collection refers to data that is collected for a different purpose, but used to answer another research goal (Hox & Boeije, 2005). Hence Lehmann & Bengart (2014) refer to data collection as a process of gathering information about the topic to be investigated using a systematic approach.

In research methods, the quantitative approach is used to obtain answers pertaining to the research question, testing hypotheses and evaluating possible outcomes (Lehmann and Bengart, 2014). This study, however, made use of the qualitative, inductive approach to collect data from a series of interviews in order to obtain an in-depth analysis of the data collected from the sample. Since the study is explorative in nature, the socio-technical systems (STS) theory was used as the grounding theoretical framework. The STS are mainly used to gain an in-depth perception about an identified problem in the environment (Trist, 1981). Primary data was gathered from the interviews, while secondary data was obtained from desktop research found in academic journals, books, conference proceedings, peer reviewed articles, Google Scholar, Research Gate, ACM Digital Library, PubMed, SAGE, EbscoHost, and Elserivier, all of which form the basis of the literature review.

1.7.6 Data Analysis

After transcribing the interviews captured, the researcher selected thematic analysis as the technique to analyse the data collected. The use of thematic coding and analysis assisted the author to retrieve articles with similar meaning at a later stage. Since the study sought to explore the reasons for a specific phenomenon, similar ideas or patterns were identified and categorised to derive meaning that shed light and assisted in the answering of the research question. In addition, relevance of the subject matter was tested so that the findings of the study were relevant and usable. The relevance test involved the predominant use of literature within a five-year period. The data analysis of this study was performed manually due to non-availability of tools during the time of COVID-19.

1.7.7 Data Trustworthiness

Trustworthiness in data involves data that is credible, transferable, confirmable and dependable. Qualitative data does not include the use of metrics to prove data trustworthiness, but the credibility, transferability, confirmability and dependability must be visible.

Credibility in data can be found when the evidence of true and accurate interpretation of the study's findings is available. This can be achieved through member checks which involve allowing participants to double check the transcribed data for accuracy (Olsen, 2004). Credibility of this study, however, was established by conducting informal member checks.

Data transferability can be demonstrated when data is subjected to other forms of data analysis techniques and still produces the same result (Trochim, 2006). Thus Trochim (2006) states that the degree of generalisation to other contexts will prove that data is transferable. The

sample size of this study does not lend itself to generalisability; however, the rich data provided an in-depth perspective of the environment in which the elderly find themselves and future research, using quantitative measures of a much larger sample, could very possibly corroborate these findings.

Confirmability of data refers to the degree of confirmation by other researchers (Trochim, 2006). This means that the data analysed must be able to indicate neutrality in its findings. By so doing, data is considered confirmable and not biased to suit the collectors' viewpoint. An audit trail is usually used to provide the steps taken in coding and analysing the data (Olsen, 2004).

Dependability in data can be observed from replication. If data is able to produce the same result when subjected to other methods in a similar manner, then it has proven itself dependable. This consistency may be applied by an external source as evidence of data dependability.

1.7.8 Delimitation of the Study

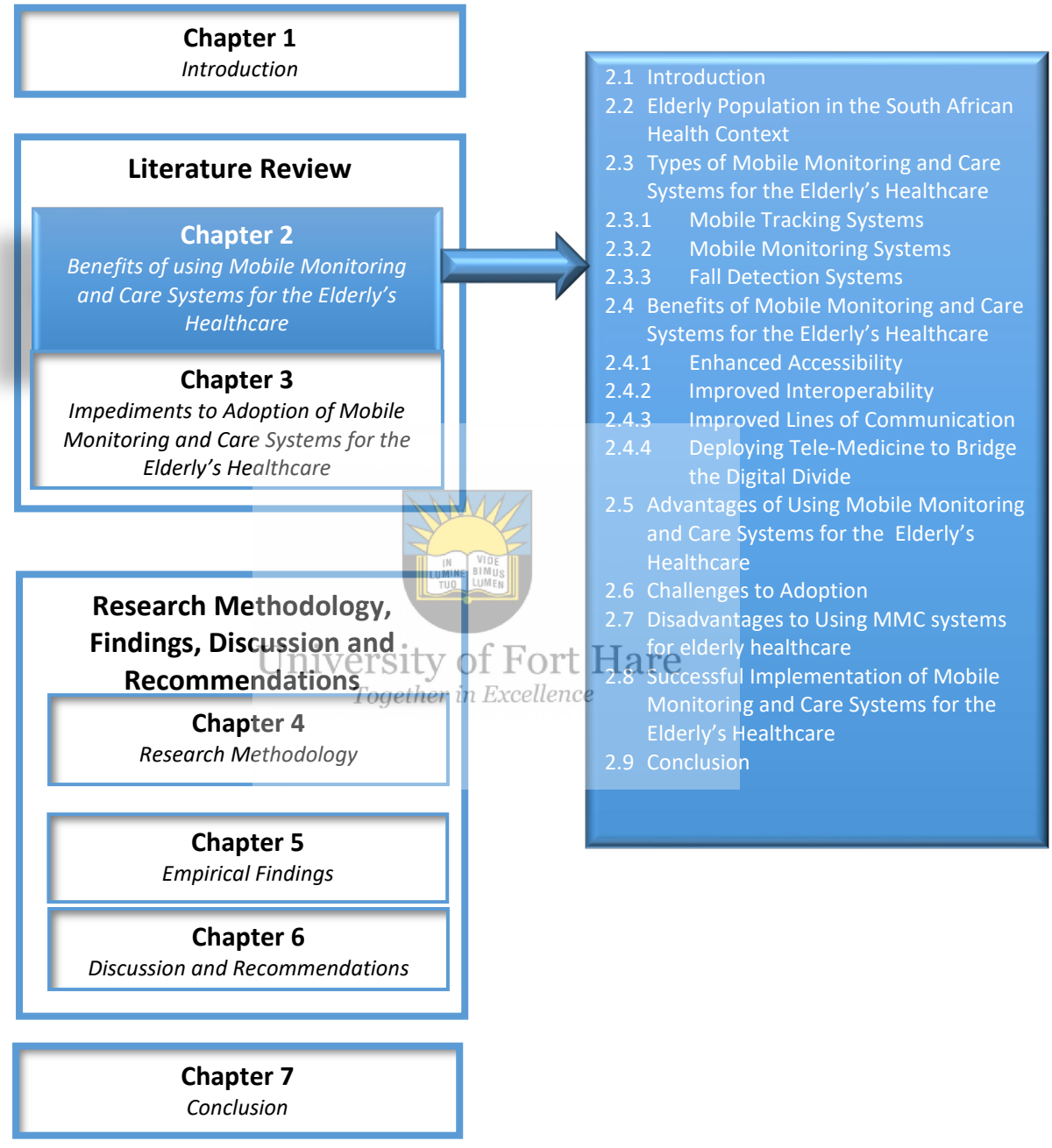
This study sought to explore why elderly people do not adopt available MMC systems to alleviate the burden on healthcare resources. The study population was limited to elderly people living at home from the Buffalo City Metropolitan Municipality (BCMM) area in the Eastern Cape (EC) province of South Africa (SA). Working with only research participants from a single case study proved to be a limitation as the researcher felt that it was not enough to represent the entire country. Only the elderly living at home (independently or with family), and a health caregiver who happened to be an elderly using a mobile device were interviewed for the study. The next section will explain ethical considerations of this study.

1.7.9 Ethical Considerations

Resnik (2013, p1) defines ethics in research as "norms for conduct that distinguish acceptable and unacceptable behaviour". Thus, participants were informed about the objectives of the study and their permission was requested before commencing with the study. The participants voluntarily signed an informed consent form following the explanation of expectations by the researcher. Only participants who fully understood the reasons for carrying out the research participated in the study. No personal information voluntarily divulged during the course of this study was used for any other reason except as a means of collecting and analysing data solely for the purpose of this study. The research was carried out in accordance with the academic guidelines of voluntary participation. The participants were assured of their

confidentiality and anonymity during and after the study. This research conformed with the ethical guidelines specified by the University of Fort Hare Research Ethics' Committee. Thus, this study acquired an ethical clearance certificate (see Appendix 1) from the University of Fort Hare Research Ethics' Committee before embarking on data collection.

CHAPTER 2: BENEFITS OF USING MOBILE MONITORING AND CARE SYSTEMS FOR THE ELDERLY'S HEALTHCARE IN THE HOME ENVIRONMENT



2.1 Introduction

As the elderly population is increasing, the national government is obliged to seek solutions to the problem of quality healthcare for the elderly (WHO, 2015). The exponential growth in life expectancy of elderly people was estimated to be at 65 years in the 1950's, 78 years in 2010 and projected to reach 83 years by 2045 (Ghazal & Al-Khatib, 2015). Kathooria (2017) states that the increase in life expectancy could be as a result of a changed social lifestyle, and modern medicine with improved access to healthcare. Zeissig et al. (2017) and West (2015) argue that a satisfied elderly community is one that has access to healthcare at affordable cost. However, there is an argument regarding the importance of human resources in the quest to deliver an effective and efficient quality healthcare to elderly people (Adibi, 2014; Varshney, 2014). Therefore, a holistic approach to the improved quality of healthcare for the elderly is dependent on access to available mobile technologies which, in turn, may deliver quality healthcare as per the World Health Organisation (WHO) deliverables.

Literature indicates that due to the chronic shortage of infrastructure and medical personnel in developing countries to meet the needs of the population, the elderly people are encouraged to stay in their communities (Borelli et al., 2019; WHO, 2015; Mohammadzadeh & Safdari, 2014). WHO (2015) further adds the assertion that when elderly people live independently, depression, social isolation and dependency variables decrease. The national government proposed the Sustainable Development Goals (SGD) initiative (Lehohla, 2019) with the primary goal of inclusion of the elderly in the community, while the African Union (AU) proposed Agenda 2063 that positions the elderly at the centre of community development (Lehohla, 2015). These efforts are all focused on the advocacy of elderly rights (Lehohla, 2015). In general, the burden of healthcare for the elderly is very high and large resources are required to monitor and care for this population (McCallum, 2017). While mobile monitoring and care (MMC) systems could assist in the monitoring of elderly people, human resources are still needed to offer a holistic service to the elderly living at home (Ferreira, 2017; Nikou, 2015). This chapter seeks to explain the benefits of using MMC systems for the elderly in the home environment.

2.2 The Elderly Population in the South African Health Context

The world is faced with the phenomenon of a growing elderly community and South Africa is no exception (WHO, 2015. Elderly people refer to all individuals chronologically aged 60 and above (Ferreira, 2017). The elderly demographic comprises about 8% of the entire South

African population (Lehohla, 2019). In terms of the Older Persons Act (2006), all elderly people have the right to dignity, safety, health services, and basic needs such as applicable to all citizens of the South African Republic. However, there are challenges that prevent the elderly people in South Africa from accessing their basic fundamental rights as enshrined in the constitution (Lehohla, 2019).

The South African government provides elderly people who do not belong to a pension fund with an old age grant to the value of R1780 per month. This is to assist the elderly in covering living expenses and other incidentals, including healthcare (Government, 2004). Due to the rising costs of healthcare and the expensive cost of living, elderly people, especially those that are dependent on old age grants for daily sustenance, cannot afford the services of private healthcare centres. As a result, the Department of Health is facing a huge strain on healthcare resources as elderly people are mostly dependent on government for their healthcare needs (Lehohla, 2019). The state of fragmentation of the health systems contributes to the situation as elderly people find themselves subjected to repetitive procedures when visiting healthcare centres (Wilson et al., 2014). It is reported that elderly people would rather not visit healthcare centres; they would rather avoid the numerous time-consuming protocols commonly found in healthcare centres, especially those that are state-owned (Badisa, 2017; McCallum, 2017; Lehohla, 2015).

Farrell (2017) has found that the number of elderly people who would prefer to live in institutionalised care is significant. However, the prevailing socio-economic situation in the country prevents the elderly from accessing old age homes (OAHs). The situation is exacerbated by the chronic shortage of housing for the elderly, who end up living in extended family environments (Ferreira, 2017). Research indicates that this living arrangement often contributes to the neglect and abuse of the elderly (Lehohla, 2019); Kasiram & Holscher, 2015). The prevalence of the elderly's abuse reportedly emanates from the desperate circumstances that extended family members find themselves commonly subjected to, as a result of the unfavourable socio-economic conditions in the country (Kasiram & Holscher, 2015). Since elderly people receive an old age grant, the family members are more inclined to claim from that money for services rendered. Research attributes increasing levels of abuse and neglect to the socio-economic ills, like an excessively high unemployment rate facing South Africa (Kasiram & Holscher, 2015). The elderly people thus do not have sufficient finances, despite being supported by the old age grant scheme, to deal with their healthcare as they are

considered ‘bread-winners’ by their families (Kasiram & Holscher, 2015; Ferreira & Lindgren, 2008).

Government efforts to alleviate the burden on healthcare resources are at an infancy stage, due to a lack of awareness about issues that affect the elderly. The South African Human Rights Commission (SAHRC) report (2015) into elderly concerns reports that approximately 30% of elderly people in South Africa suffer from medical conditions that need medication. Inadequate healthcare for the elderly is highlighted as a major cause for concern given the exponential growth of the elderly population (Lehohla, 2019). In the effort to alleviate the challenges faced by the elderly, government has identified the use of technology to alleviate the burden on healthcare resources.

Government is currently looking into mechanisms that have been used by developed countries to reduce the burden on healthcare resources. The MMC systems for elderly healthcare have thus been earmarked to be the enablers of an improved healthcare for the elderly population. Literature indicates that there is a chronic shortage of health infrastructure and medical personnel to meet the needs of the elderly population in developing countries (Borelli et al., 2019; WHO, 2019; Mohammadzadeh & Safdari, 2014). The use of MMC systems for healthcare carry possible benefits which, in return, enable a better quality of life for the elderly communities (Kasiram & Holscher, 2015). When elderly people live independently for as long as possible, there is a noticeable reduction of mental illnesses such as depression among them, while social isolation and dependency variables decrease as well (Kasiram & Holscher, 2015; Ferreira & Lindgren, 2008).

Electronic Health (eHealth) was reportedly the platform deployed by other countries to improve the quality of healthcare for elderly citizens. This eHealth refers to the use of information and communication technologies (ICT) to access healthcare (West, 2015). Despite the ubiquitous nature of eHealth for healthcare, these available technologies are still not used to the optimum to reduce the burden on healthcare resources especially in developing countries. Several factors have been identified as impediments to the adoption of technology for healthcare including attitudes and perceptions, privacy, security and trust, affordability, and appropriation (Vandenberghe et al., 2018; Wilson et al., 2017). In order to understand the potential of eHealth as a possible enabler to reduce the burden on healthcare resources, a full exploration of the benefits of the technologies becomes imperative. The narrative of the potential benefits of eHealth includes the use of MMC systems. As stated earlier in the

manuscript, MMC systems refer to systems that make use of mobile devices and technology to monitor patients (Kudzai & Cilliers, 2016).

There are different types of MMC systems available as stated before too: these types include using wireless sensor networks (WSNs) to monitor vital signs, bed sensors, heart rate monitors and fall detection monitors to name but a few (Peek, et al., 2016). Smartphones and other devices with Internet of Things (IoT) capabilities offer many possibilities in the delivery of the elderly's healthcare. An example of this is the smart pillbox which uses IoT connectivity. The smart pillbox is an application (app.) that reminds the person to take medication. These systems will be discussed in more detail in Section 2.3 below. The use of mobile technology as a biomedical imaging tool has also been identified as a monitoring tool that has potential healthcare cost reduction benefits (Eggeling, 2018). These bio-imaging tools have been found to be useful in developing countries like Tanzania where geography and access to internet are a challenge. Such MMCs can therefore be defined as technologies that can drive the eHealth agenda as per Agenda 2063 (WHO, 2015).

This means that in order to attain a comprehensive and robust health system, MMCs can play a pivotal role in enabling the adoption and implementation of a less burdened healthcare system whose fundamental aim is to provide the elderly people with an improved quality of life through attainable healthcare. In developed countries, WSNs have been used in mobile monitoring and smart environments to enhance adherence and improve access to the elderly's healthcare. In the context of smart environments, MMC systems are embedded within smart technologies and play a crucial role in delivering monitoring, tracking and fall detection among the elderly population. Smart technology refers to the use of artificial intelligence, big data and analytics to perform self-monitoring and analysis and reporting activities (Bowers, 2020). The convenience provided by smart technologies has the potential to reduce costs and other related costs. Benefits of using MMC systems for the elderly's healthcare are discussed in Section 2.4 below.

2.3 Types of Mobile Monitoring and Care Systems for the Elderly's Healthcare

The following section briefly discusses some of the different technologies available in the market that can be used for tracking, monitoring, and fall detection capabilities. There are various types of devices developed with monitoring capabilities that can be used by and for elderly people. For elderly people living independently, availability, affordability and usability become key aspects of any device that will be considered useful (Ghazal & Al-Khatib, 2015).

Ghazal and Al-Khatib (2015) advocate the use of MMC systems for the elderly living at home because of the user-friendly and ease of use properties of the technologies utilised by the mobile devices. In addition, MMC systems address the issue of immobility by offering convenience, sustainability, safety and improved efficiencies embedded in their mobile devices (Bowers, 2020). The ubiquitous nature of mobile devices provides the elderly with the convenience of mobility in their living spaces by using remote controlled-devices. Tsang, Lam, Qureshi, Ng, Papavasileiou and Han (2018) further make the assertion that intelligent sensors can assist the elderly with the tracking capabilities provided by the activity tracking monitors and sensors found in indoor activity tracking monitors. These tracking monitors can be useful to the elderly people, especially for those with Alzheimer's disease.

2.3.1 Mobile Tracking Systems

A mobile tracking system is a mobile device that uses sensors embedded within the device. The elderly person would need to simulate the motions that they would ordinarily perform when they are on their own. The pre-determination aspect is then used to scope the boundaries when in use by the elderly person who has limited mobility (Tsang, et al., 2018). This type of device can be largely assistive for its tracking capabilities, which allow the elderly the confidence to move around at the home environment more independently, thus reducing the feeling that they are burdensome (Tsang et al., 2018; Ventola, 2013). The SmartMind system is an example of an intelligent tracking sensor which makes use of the Kinect 3D depth camera. SmartMind devices deploy the camera to measure the perimeter and record the measurement for future use by the person using them. When the elderly person steps outside the predetermined boundary, an alert message is automatically sent to the family and the response alert team.

Another device available for elderly healthcare use is the TEMPO, a wearable device that keeps track of the whereabouts of elderly people (CarePredict, 2019). The main functionality of this device is to locate the elderly person at all times by deploying sensor technology, thus keeping a record of the whereabouts of the elderly person. Elderly people suffering from Alzheimer's and their families could largely benefit from ownership of this device.

2.3.2 Mobile Monitoring Systems

Mobile monitoring systems are devices that have built-in monitoring capabilities as part of their design. The main aim of such devices is monitoring, like the mobile device used to monitor blood glucose and blood oxygen levels in the home environment. AccuCheck is an

example of a mobile monitoring device usable in the home environment. These devices will make an alerting sound when abnormality is detected. For diabetic patients, a blood sample is inserted into the device and the level of blood glucose is then displayed. This type of monitoring assists the elderly patient with monitoring and adherence in the living space.

Smart hearing aids are designed to monitor hearing levels with the help of a smart phone. An elderly person that is fitted with a hearing-aid can monitor their hearing levels by using the smart technology on the mobile app (Maidment, Barker, Xia, & Ferguson, 2016). Elderly people are allowed the capability of a comfortable interaction with their environment by using the smart device which regulates noise and operates in real mode. This means there is no delay in the transmission of information between the elderly person and the mobile device (Keidser & Convery, 2016).

The pacemaker is another type of wearable monitoring device that is used for elderly healthcare (Evans, Papadopoulos, Silvers, Charness, Boot, Schlacta-Fairchild, Crump, Martinez & Ent, 2016). The major functionality of a pacemaker is monitoring. A pacemaker is a mobile device that is inserted into the elderly patient to monitor and control anomalies in the heart rhythm. Although the device does not use sensors in the traditional sense, it offers remote monitoring to the person wearing it. The elderly person would then inform the health caregiver of the detected abnormality. The device is battery operated and it would provide the elderly with the necessary monitoring function to restore the balance required by the heart (Evans et al., 2016).

The GrandCare system is another device whose primary functionality is to monitor glucose, blood pressure, oxygen and weight of the elderly person living independently. The device uses a data repository which is constantly monitored and sends signals to the emergency services upon activation. When the MMC system in the device sends an alert to the emergency services, a signal is also sent to the pre-chosen people recorded on the mobile device. The MMC system used operates in real-time and that assists with decision-making (Evans, et al., 2016). The device offers regular reminders, alarm capabilities and medical guidance which, in turn, offers increased convenience and comfortability to the elderly people (Borelli et al., 2019; Lv, Xia, Wu, Yao, & Chen, 2010).

Some authors include remote health monitoring capabilities when referring to mobile monitoring systems (Lv et al., 2010). The MMC systems would adopt a tailor-made approach to suit the custom needs based on the elderly person's health condition (Evans et al., 2016). The built-in monitoring capabilities of the wearable device can bring peace of mind to the

family members of the elderly, who are the primary caregivers. Mobile monitoring systems are also useful to monitor adherence in patients remotely. This functionality is important as it provides information in real-time mode, especially in elderly people who have undergone transplant procedures (Vandenberghe et al., 2018). Literature indicates that these devices perform living assistant duties in that they can also undertake the capabilities of fall detection devices (Heath, 2020; Charness et al., 2016; Evans et al., 2016; Mohammadzadeh & Safdari, 2014).

2.3.3 Fall Detection Systems

Developing countries have made great inroads into deploying monitoring and tracking devices for elderly healthcare, especially for older adults living independently. MobileHelp Duo and Philips GoSafe2 are examples of mobile devices available only in the United States for monitoring the elderly in their living spaces as well as off site. These systems use WSN and voice communication capabilities to detect falls in the elderly (Bowers, 2020). MobileHelp Duo is a wearable fall detection device worn around the wrist or the neck.

Recent developments in the quest to provide improved solutions for elderly healthcare include the use of IoT based solutions for the enhancement of elderly healthcare and quality of life (Borelli et al., 2019). Home Assistance Based on the Internet of Things for the Autonomy of Everybody (HABITAT) is one of the technologies used to assist elderly people to stay in their home environments in safe conditions, without subjecting them to institutional healthcare (Borelli et al., 2019). This type of monitoring makes use of Radio Frequency Identification (RFID) technologies and wireless sensor networks (WSN) and offers interoperability between the available mobile devices and their main functionality is fall detection (Borelli et al., 2019; White et al., 2016).

2.4 Benefits of Mobile Monitoring and Care Systems for the Elderly's Healthcare

Literary sources suggest that the potential benefits of using MMC systems for the elderly's healthcare can be categorised into primary and secondary factors (Ghazal and Al-Khatib, 2015). Researchers also make the assertion that using MMC systems for healthcare has potential advantages. The primary advantages include, but are not limited to, enhanced accessibility, improved inter-operability, open communication lines between patients and healthcare workers as well as deploying tele-medicine to bridge the digital divide (Aghanavesi, Nyholm, Senek, Bergquist, & Memedi, 2017). The secondary benefits include reduced access costs, centralised and structured non-fragmented healthcare system, faster decision-making as

well as convenience and comfort in the home environment (Bowers, 2020; Mohammadzadeh & Safdari, 2014).

2.4.1 Enhanced Accessibility

Accessibility to healthcare is two-fold. There is access to the device and access to information (Zeissig et al., 2017). The ubiquity of MMC systems allows for easier access to healthcare. When there is access to the device, the elderly person may have remote access to the healthcare worker. In some cases, geography poses a challenge and this is one way that could be used to reduce the geographical constraints that act as barriers to accessing healthcare for the elderly.

Access to information relates to the use of smart phones to access health information (Zeissig et al., 2017). In this context, information found on the web is more accessible due to the ubiquity of smart phones.

2.4.2 Improved Interoperability

The design features of the MMC system platforms have advanced capabilities which allow for interoperability. An elderly person who is distressed may activate the distress signal in the wearable fall detection device to trigger an alarm. The alert is transmitted to the data centre and assistance is dispatched to the location. All of this is made possible by global positioning system (GPS), wireless sensor networks (WSN) and radio frequency identification (RFID) capabilities which are available in fall detection devices like the GoSafe2 and MobileHelp Duo (Borelli, et al., 2019).

2.4.3 Improved Lines of Communication

The nature of some devices allows for improved communication by deploying WSN, GPS and RFID technologies (Ovando, Garcia, Escalante & Nolasco, 2018; Tsang et al., 2018). Physician to physician communication may be enhanced through tele-medicine. Specialist doctors challenged by geographical constraints make use of remote sensing devices for decision-making. Physician to patient monitoring may also be enhanced, which could facilitate improved adherence (Chiridza, Wesson & Vogts, 2019). The improvement in communication is evident when a specialist observes and offers clinical supervision, even when they are not in the same procedure room, thus providing remote guidance in the absence of expertise (Sen, Aydogdu, Yonguc, Bozkurt & Bolat, 2016).

2.4.4 Deploying Tele-Medicine to Bridge the Digital Divide

Tele-medicine can be used to bridge constraints caused by the digital divide in healthcare work (Aghanavesi, Nyholm, Senek, Bergquist & Memedi, 2017; Moon & Chang, 2014). There is

increased adoption by physicians who have otherwise not ventured into tele-medicine (Talboom-Kamp, Verdijk, Kasteleyn & Numans, 2018; Murnane, Huffaker & Kossinets, 2015). The use of tele-medicine could be used to encourage elderly people who have the devices, but have no compunction about using them, thus adopting a more pro-active approach to their healthcare. Tele-medicine could also play an assistive role during emergencies in the absence of emergency medical personnel (Talboom-Kamp et al., 2018). According to Sen et al. (2016), using tele-medicine can be beneficial for enhanced patient care. The level of adherence and monitoring could be increased if tele-medicine could be used in a meaningful manner by elderly people and their health caregivers. The major benefit of tele-medicine is the continuity of healthcare when it is most needed (Sen et al., 2016).

2.5 Advantages of Mobile Monitoring and Care Systems for Healthcare

Mobile technologies for healthcare have been found to possess the potential to revolutionise healthcare (Kathooria, 2017; West 2015; Ghazal & Al-Khatib, 2015; Mohammadzadeh & Safdari, 2014; Murphin, 2013). Vandenberghe, (2018), Ghazal and Al-Khatib, (2015) and Mohammadzadeh and Safdari (2014) strongly advocate for the inclusion of MMC systems as an imperative for the healthcare of the elderly. The ubiquitous nature of mobile devices can thus be an enabler that allows for enhanced access to health care by marginalised populations like the elderly (Zeissig et al., 2017).

The MMC systems are deemed useful tools for patient monitoring (Charness et al., 2016). Physicians can monitor their patients in remote and rural areas by using MMC systems found in the mobile technologies. Elderly patients who suffer from mental conditions like Alzheimer's and transplant patients could be monitored remotely with the assistance of MMC systems that have perimeter tracking capabilities built into them, like the MobileHelp Duo and GoSafe2 devices (Vandenberghe et al., 2018). The use of WSN and IoT technology becomes pivotal in offering a holistic service to the elderly's healthcare.

The MMC systems also have the capability to reduce the burden on the healthcare resources, by offering improved efficacies that may increase the adoption of the technologies (West, 2016). Murnane, Huffaker and Kossinets, (2015), argue that the adoption of MMC systems can also assist the healthcare workers to improve their effectiveness. Most healthcare researchers argue that healthcare professionals are then allowed the time to concentrate on their core business, thus enhancing perceived usefulness of the healthcare centres (Murnane et al., 2015).

In addition, physicians can be largely assisted by MMC systems to improve decision-making, especially for case management (Nikou, 2015).

The use of MMC systems carries the potential to reduce the high level of fragmentation within the landscape of South African healthcare system that currently has many systems in place. This fragmentation adds unwanted strain on the elderly who face, among other challenges, high healthcare costs. Elderly people find themselves subjected to repetitive procedures when visiting healthcare centres. The use of MMC systems for elderly healthcare may provide a solution to the South African problem of a fragmented healthcare systems by using IoT and WSN to enhance the health and thus the quality of life of elderly people (Ovando, Garcia, Escalante, & Nolasco, 2018). Literature indicates that there is an urgent need for mobile technology to be fully and totally integrated into, and for, healthcare (Ghazal & Al-Khatib, 2015).

2.6 Challenges Associated with Using Mobile Devices for the Elderly's Healthcare

Although there is much dialogue pertaining to the availability of mobile devices for elderly healthcare, there still seems to be a low adoption rate attributed to factors discussed in the section below (Chiridza, Wesson & Vogts, 2019). Attitudes, behaviours and perceptions; privacy, trust and security concerns, affordability, as well as appropriation appear to be the major impediments to improved adoption rates of mobile devices for healthcare of the elderly (Vandenberghe et al., 2018; Kasiram & Holscher, 2015; Ferreira & Lindgren, 2008). Physiological aspects preventing access to mobile devices, like the 'smaller is smarter' mantra commonly used by designers, need to be removed (Charness et al., 2016). These design constraints add to the low adoption rate of mobile devices by the elderly as they are seen to add to the exclusivity and mistrust in technology experienced by the elderly population (Charness et al., 2016; Nikou, 2015; Moon & Chang, 2014).

According to literature, elderly people have a natural distrust of technology and most of them are referred to as digital dinosaurs (Evans, et al., 2016). The reason for the mistrust of technology can be attributed, to a large extent, to elderly people's inadequate awareness of the benefits of using mobile devices for their health. Despite the benefits of using MMC systems, elderly people have a challenge in adopting technology in its entirety (Evans et al., 2016). It is reported that elderly people consider it a cumbersome exercise to learn how to use the devices in their old age and would rather have caregivers do it for them (Vandenberghe et al, 2018; Zeissig et al., 2017). Access and availability of MMC devices is further hindered by the fact

that these devices are sold by different companies and at different costs. While the users could be faced with the challenge of cost and affordability, there are related costs especially in developing countries like South Africa, where the elderly use state resources for healthcare (White et al., 2016). The following section seeks to briefly describe the disadvantages associated with using mobile technologies for the elderly's healthcare.

2.7 Disadvantages of Using Mobile Monitoring and Care Systems for the Elderly's Healthcare

The use of mobile devices may increase the risk of social isolation (Nikou, 2015). Researchers into the use of mobile devices for healthcare argue that elderly people are more prone to experiencing decreased social interaction as they refrain from using their devices in a social atmosphere. It is reported that elderly people become uncomfortable when the mobile devices have to be used in a social environment and would rather use the devices in the privacy of their own homes, as they consider them intrusive in the above perspective. The implication here is that of social exclusion, especially for elderly people who need constant monitoring (Vandenberghe et al., 2018). The following section briefly describes the challenges emanating from use of MMC systems for the elderly's healthcare.

2.7.1 Attitude, Behaviour and Perception

The intrusive nature of some mobile devices creates a negative attitude towards the use of MMC systems for the elderly's healthcare (Peek, et al., 2016). Several researchers colloquially term such people 'digital dinosaurs'. A digital dinosaur is any elderly person born outside of the digital age, but who has migrated to technology, even if in a limited way (Prensky, 2001).

Literature indicates that there is a tendency not to engage with MMC systems because of the anxiety issues developed by elderly people when confronted with design constraints experienced when opening and using mobile devices (Zainal, Ahmad, & Razak, 2015). As a result, the elderly people develop a negative attitude towards mobile devices emanating from their lack of access skills (Zeissig et al., 2017). The argument then becomes that there should be considerations about user participation, which should be inclusive of the elderly voice. It is hoped that these considerations will prove fruitful during the exploration of user and behavioural intention of elderly people to use MMC systems for their healthcare (Zainal et al., 2015).

The other dimension of this discussion pertains to the perception of elderly adults regarding access to healthcare. While age in and of itself may not necessarily bankrupt the healthcare system of a country, increase in age and the poor planning on how the healthcare system is used may well lead to the deterioration of a country's healthcare system (Alves da Costa, Teixeira, Duarte-Ramos, Proenca, Pedro, Furtado, Aranda da Silva & Cabrita, 2016). Thus, the governments globally are faced with the duty of ensuring that access to healthcare should be equal across the spectrum.

2.7.2 Privacy, Security and Trust Concerns

There are questions raised regarding who has access to the elderly's health information and what is done with the available information. This brings the argument of unauthorised access to patient health information (PHI), thus resulting in security concerns and attitudes of mistrust amongst the elderly (Siegel & Dorner, 2016). Boucher (2013) corroborates this viewpoint by adding that the automation of systems increases the mistrustful nature held by elderly people towards mobile technologies and resurfaces the argument about loss of control. Elderly people are more inclined to distrust what they are not comfortable with, as is the case with mobile devices. It is this desire to assume control of their PHI and the mistrust that is inherent in the relationship between elderly and technologies that leads to the privacy paradox (Balla, 2017).

Although the elderly folk have concerns pertaining to the use of technology, there seems to be a general willingness to share health data with healthcare professionals, if it will benefit the elderly's health (Vandenberghe et al., 2018). The willingness to receive rewards amidst the security concerns can be referred to what is commonly known as the 'privacy paradox'. The privacy paradox refers to the inconsistent manner in which privacy attitudes and privacy behaviours are presented by people (Kokolakis, 2017).

Due to the ubiquity of mobile devices for the elderly's healthcare, ethical issues need to be considered. While it may be assistive to share health data especially among healthcare workers, confidentiality and privacy of patient information remains a serious consideration as per the Protection of Personal Information (PoPI) Act, 2013 (Kudzai and Cilliers, 2016). In light of the above arguments, serious ethical considerations are necessary to ensure that privacy concerns raised by elderly people are realised by invoking privacy protocols like Health Insurance Portability and Accountability Act (HIPPA), 1996.

2.7.3 Affordability

While there may be solutions available to enhance the adoption of mobile monitoring technology for the elderly people, the issue of affordability remains an impediment to the total adoption of mobile monitoring technology for healthcare (Murnane, Huffaker & Kossinets, 2015). The issue of affordability in South Africa is two-pronged: it involves the cost of technology and the high costs of internet usage to run the technology. Ferreira (2017) argues that, because of the socio-economic landscape prevailing in the country, most elderly people - especially those dependent on welfare grants for survival - would sacrifice their healthcare issues for humanitarian purposes.

The major concern in literature is the rising cost of healthcare in developing countries (Chiridza et al., (2019). South Africa has a high bandwidth rate while facing a high unemployment rate as approximately 6,7 million people are unemployed (Statistics South Africa, 2019; Ferreira, 2017). The challenge implied by the above statement could be that, while the choice to be humanitarian to family can be considered altruistic, the end-result could have far more devastating effects on families (Kasiram & Holscher, 2015).

It is reported that given a choice between the purchase of a mobile device and a food parcel, the elderly person would choose the latter in order to provide for the family that is highly affected by the adverse socio-economic state prevailing in the country (Ferreira, 2017; Kasiram & Holscher, 2015). The other aspect relating to the above argument is that, in the South African context, safety of the elderly with mobile devices could be compromised (Borelli, et al., 2019; Kasiram & Holscher, 2015). Hence the prevailing socio-economic conditions in South Africa are considered to be an impediment to the total adoption of MMC systems for healthcare (Chiridza et al., 2019; Statistics South Africa, 2019).

Developed countries have systems in place to ensure an improved quality of life for the elderly people in their care (Talboom-Kamp, Verdijk, Kasteleyn & Numans, 2018). Developing countries are still struggling with understanding technology, rising costs of healthcare, inadequate infrastructure and a general lack of understanding of pertinent issues relating to the elderly's plight (Borelli et al., 2019; White et al., 2016; Adebesin et al., 2013).

Another aspect relating to affordability involves accessibility of technology in remote areas. Tele-medicine is considered to be a solution for the elderly people in rural and remote areas. However, not all elderly people have access to the internet. Research attributes the lack of access to high data costs which prevent services from reaching rural and remote areas.

2.7.4 Appropriation

Appropriation refers to the use of mobile devices like smartphones for reasons other than that for which they were originally designed (Vandenberghe et al, 2018). Researchers of MMC systems for elderly healthcare state that elderly people find various uses for mobile devices to enhance their health and, thus, their quality of life. As MMC systems are considered to be the enablers to a better quality of healthcare especially for the elderly, concerns are still raised on the meaningful use of these devices (Wilson et al., 2014). However, this statement needs further validation by exploring whether the available technology co-exists with the healthcare systems available to afford elderly people with improved healthcare services (Vandenberghe et al, 2018; Mohammadzadeh & Safdari, 2014; Wilson et al., 2014). Based on the above backdrop, Nikou (2015) argues that the holistic approach to an enhanced quality of life for geriatric care should include the extensive use of mobile devices at low costs.

The above argument is reported to have a negative impact on adoption of MMC systems for the elderly's healthcare. Some authors indicate that elderly people develop scepticism when they are unsure about adopting technologies for mobile monitoring as a result of not being exposed to how the mobile devices work. The idea of being trained on the use of mobile devices for healthcare is considered 'cumbersome', especially in light of the unreliability of the South African bandwidth landscape which is at most expensive and can be volatile (Chiridza, Wesson & Vogts, 2019; Vandenberghe et al, 2018). The non-reliability of MMC systems further exacerbates the low uptake regarding adoption of mobile technologies.

2.8 Successful Implementation of Mobile Monitoring and Care Systems for the Elderly's Healthcare

Research shows that developed countries have, to some extent, adopted MMC systems for healthcare (Bowers, 2020; Heath, 2020). Some countries have used smart technology as the drivers of mobile monitoring, tracking and fall detection for the elderly's healthcare. Denmark is one of the countries that has adopted the use of MMC systems for healthcare (Lerche, 2017). The following section is a brief account of MMC systems adoption in some developed countries.

2.8.1 The Adoption of Mobile Monitoring and Care Systems for the Elderly's Healthcare in Denmark

The Danish Center for Social Science Research currently referred to as VIVE was commissioned to undertake research to investigate the use of mobile technology for the

elderly's healthcare (Hojgaard & Kjellberg, 2017). The diagram below is a summary of the findings from the commission which basically reflect that health and welfare needs of the elderly need consolidation and integration with mobile smart technologies to provide a holistic offering (Lerche, 2018).

The Danish Institute for Local and Regional Government Research reports that the enormous expectations of smart technologies should also focus on reliability (Lerche, 2018; Hojgaard & Kjellberg, 2017). Lerche (2018) warn against taking implementation plans for smart technologies as a foregone conclusion. In addition, project implementation plans and project value should be awarded more focus in order for smart technologies to achieve longevity (Lerche, 2018). According to Lerche, (2018), there were certain criteria used to ensure the adoption of smart technology and they are briefly discussed in the following section.

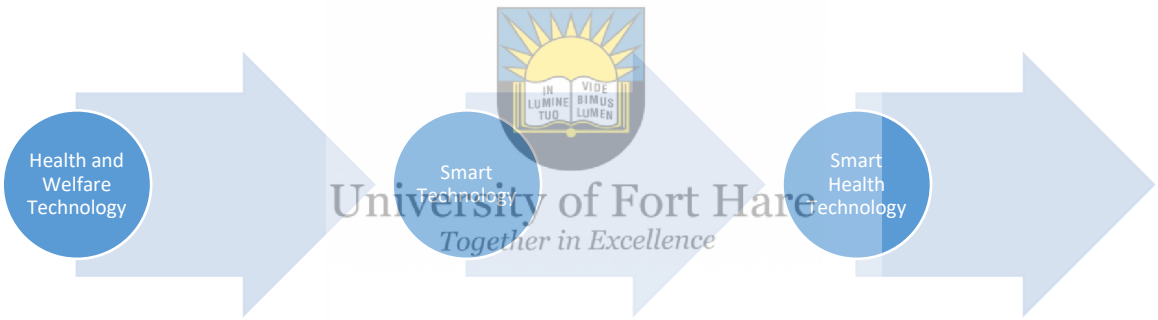


FIGURE 2: DEPICTION OF MOBILE MONITORING AND CARE TECHNOLOGIES (LERCHE 2018)

2.8.2 The Adoption of Mobile Monitoring and Care Systems for the elderly's healthcare in the United States of America

The United States has developed MMC systems for senior citizens ranging across the artificial intelligence (AI), WSN spectrum. The following mobile devices were developed in the United States between 2008 and 2017:

2.8.2.1 MobileHelp Duo

MobileHelp Duo is a tele-communication mobile device with GPS tracking capabilities designed for seniors in the United States of America in 2008. It offers a combination of medical alert as well as fall detection systems. The device is portable and can be used in the home and can be carried around and used anywhere where there is American Telephone & Telegraph (AT & T) tower coverage in the United States. In case of an emergency, assistance is available at the touch of a button. The mobile device makes use of a two-way radio system which transmits signals to the response centre. The response associate then notifies family and alerts emergency personnel. GPS capabilities on the device are invoked to locate the user. The response associates are all certified by the Security Industry Association (MobileHelp Duo, 2020).

FIGURE 3: SCREENSHOT OF MOBILEHELP DUO DEVICE (FLIPPO, 2020)

2.8.2.2 Gosafe2

Philips Lifeline GoSafe2 is an automatic fall detection mobile device. It is designed as a wearable device and uses a two-way voice connection system to communicate between the senior citizen and the response associate. The main functionality of the device is to offer assisted GPS, intelligent bread crumbs and audio beacon capabilities. In cases of emergency, the elderly person presses a button and the GPS is activated; this then allows the smart technologies embedded within the device to be deployed (Householder, 2016).

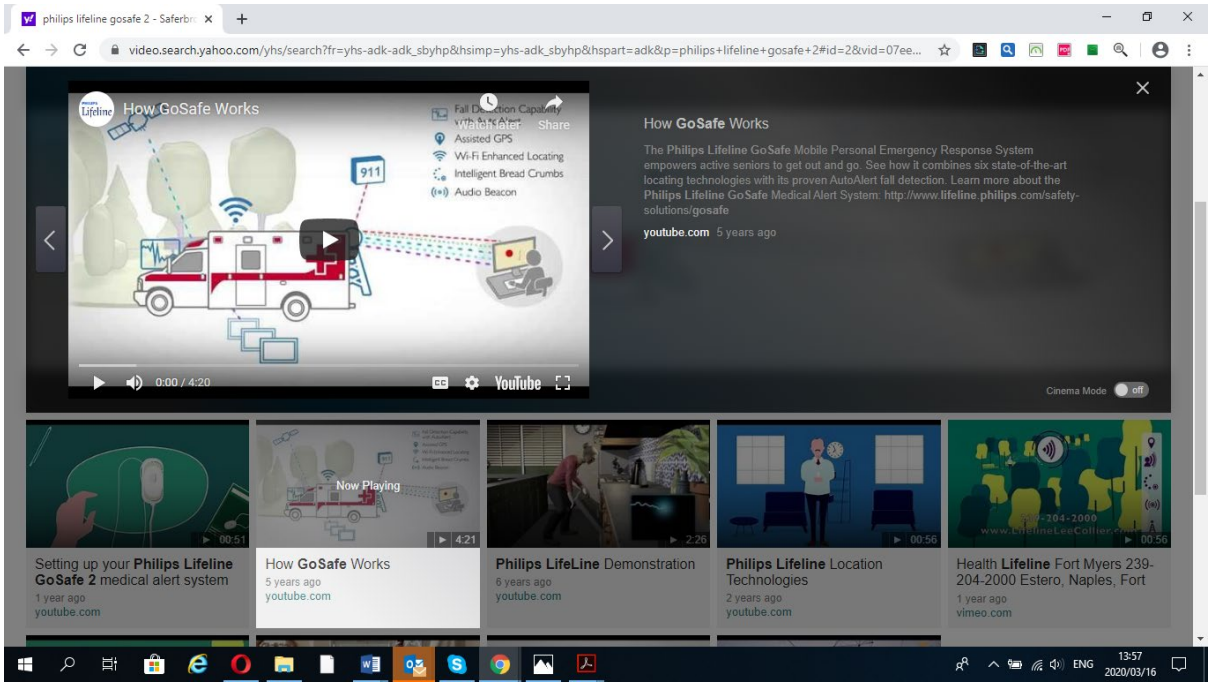


FIGURE 4: SCREENSHOT OF PHILLIPS GOSAFE MOBILE DEVICE (HOUSEHOLDER, 2016)

2.8.3 The Adoption of Mobile Monitoring and Care Systems for the Elderly's Healthcare in Japan

A pedometer is a device used to estimate the distance travelled on foot by recording the number of steps taken by a person (Asano, 2015). Ordinarily a pedometer would be used for lifestyle purposes, but for elderly people who have had transplants, it has been recommended as part of the recovery process to improve mobility (Vandenberghe, Vanhoof, Voorend, Geerts, & Dobbels, 2018). The modern pedometer assumes the role of a MMC as a wearable device to monitor movement by invoking sensor and tracking capabilities that are built into it. By the year 2015, Japan had already made significant inroads into the development and adoption of mobile technology for healthcare. According to the Yono Research Institute Limited, a pilot study was done to implement a pedometer. Recently, Japan introduced wearables for healthcare to augment its mobile technologies strategy for healthcare. In terms of the Japanese mobile technologies' strategy, there were supposed to be approximately 6 million mobile devices for healthcare developed by 2015. The mobile wristwatches were envisaged to hold about a third of these technologies for healthcare by 2020. The following diagram is an illustration of the migration of the pedometer since inception in 1965:

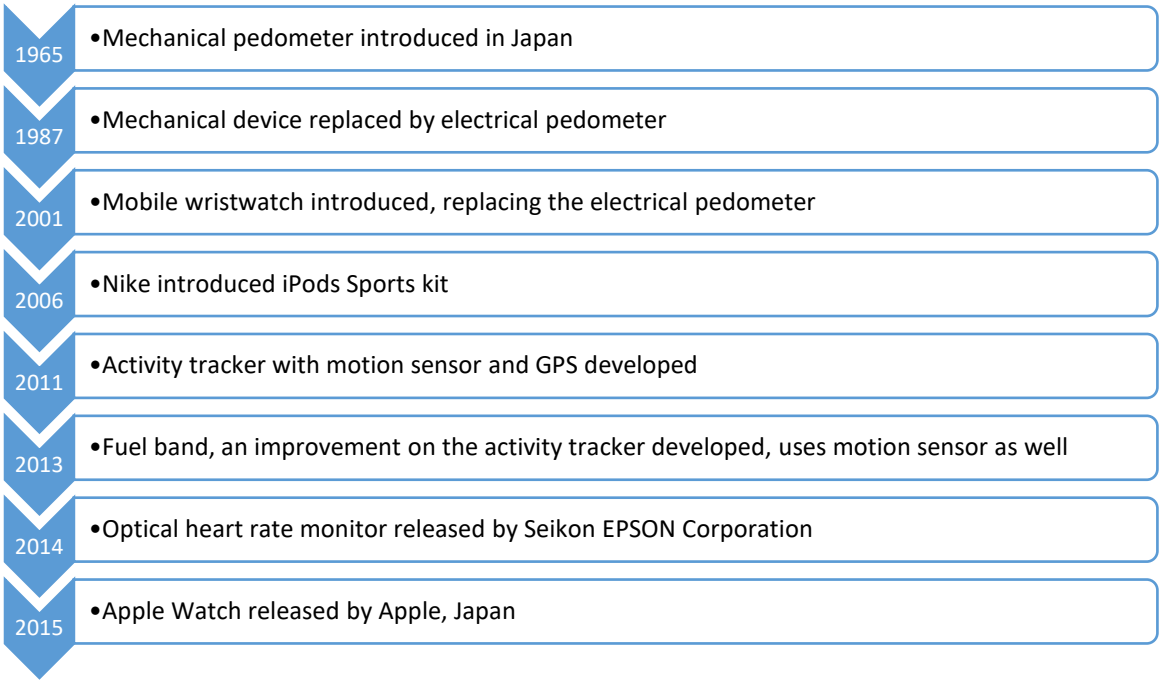


FIGURE 5: CHRONOLOGICAL EVOLUTION OF THE PEDOMETER (ASANO, 2015)

The introduction of the wireless motion sensor brought forth the realisation that if a heart could be monitored without the mobile device placed on the chest, then the technology could well be adopted for use in other areas deemed vital for healthcare. The Japanese elderly community makes use of the monitoring capabilities of the wireless motion sensor to monitor their sleeping and stress patterns (Asano, 2015). According to Vandenberghe et al. (2018), older adults have expressed feelings of shame when they have to carry around the noticeable medical devices whilst circulating in society. Vandenberghe et al. (2018) therefore makes the assertion that these mobile devices play a facilitative role in promoting adoption of mobile devices. The use of mobile technology in Japan is endorsed by the Japanese government although no regulation has been formally passed. However, the Ministry of Health, Labour and Welfare (MHLW) formulated some policies that are currently implemented as part of the promotion of healthy activities to enhance quality of life. Future endeavours in Japan include the development of a high standard smart watch for healthcare to assist towards the prevention and treatment of lifestyle related diseases. Most elderly people suffer from chronic diseases resulting from lifestyle choices in their earlier years (Asano, 2015). Other devices used in Japan include the compact blood pressure monitor and the blood glucose monitor without drawing blood. Intelligent clothes to monitor body temperature, perspiration and heart rate were already under development by 2015 (Asano, 2015).

2.8.4 The Adoption of Mobile Monitoring and Care Systems for the Elderly's Healthcare in China

As part of the Brazil, Russia, India, China and South Africa (BRICS) group of countries, China has forged far ahead of its contemporaries when it comes to technology. A mobile monitoring system known as iCare was developed to provide the Chinese elderly people with improved connectivity to advanced healthcare. Since the challenge of cost to healthcare affects the elderly globally, iCare was seen as a means of bridging the access gap and reducing healthcare costs (Chen, 2018).

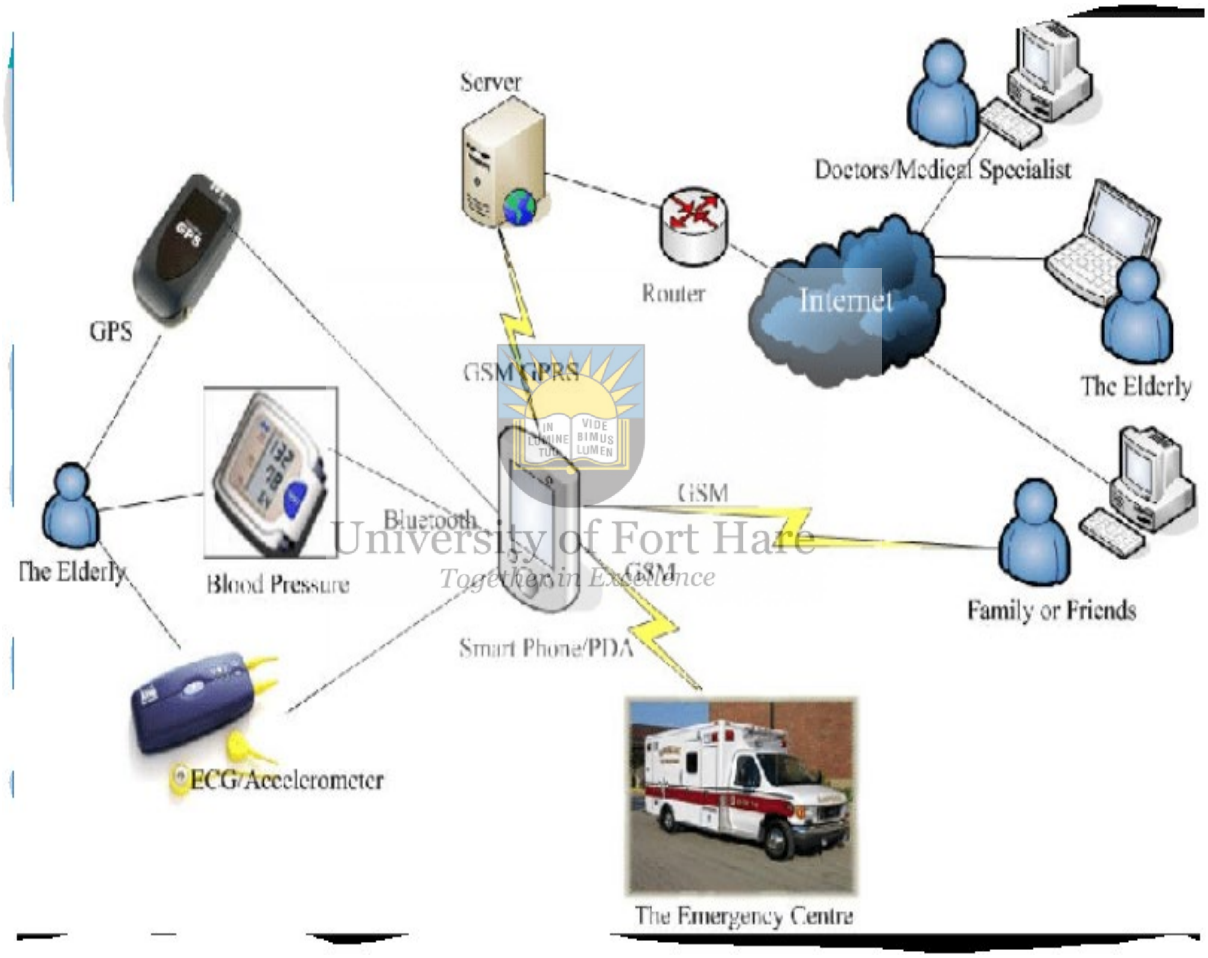


FIGURE 6: ILLUSTRATING MOBILE MONITORING TECHNOLOGIES IN CHINA USING THE ICARE SYSTEM (CHEN, 2018)

When the elderly folk use such a mobile device to monitor blood pressure or a heart condition, the device transmits the results of the test to emergency personnel via bluetooth. However, as alluded to by Zeissig et al., (2017), the access barriers identified by Rogers (1975) are indeed an impediment to the elderly people who seek to access healthcare, as well as to the medical personnel and caregivers who need the technology for decision-making. This means that if the

elderly communities do not have access to the internet, they will be unable to access the technologies. The elderly need internet connections.

Smart technologies allow companies that develop health solutions to offer solutions for healthcare and thus the design of the technology should be kept simple. This will assist in understanding how the technology works. In addition, the envisaged solution should not be considered easy as health is an intricate arena in which to succeed (Lerche, 2018). The acceptance of the solution is largely determined by the ease with which the technology can be used. Although smart technologies carry perceived benefits for healthcare, Lerche (2018) argues that extensive research should be undertaken to further explore and to ensure data accuracy.

2.9 Conclusion

The WHO reports that there is a significant increase in the number of elderly people globally. Literature attributes the increase in numbers to increased longevity emanating from improved access to healthcare, enhanced social lifestyle and a higher life expectancy linked to advanced medical technology and treatment. This report has led to global governments being called upon to devise means to mitigate the effects of a growing elderly population. The MMC systems were thus chosen as the enablers of enhanced healthcare for the elderly in their home environments. The ubiquitous nature and proliferation of mobile technology was thought to offer better opportunities in the delivery of improved healthcare for elderly people.

Mobile technology was chosen for its tracking, monitoring and fall detection capabilities to alleviate the burden of care to elderly people living in the home environment. Elderly people consider their health as a top priority and the opportunity arising from the use of mobile technology could not be left unexplored. The use of MMC systems as monitoring devices does not only augur well for the elderly patients, professionals and caregivers of healthcare can also benefit from the implementation thereof. Wearable devices with monitoring capabilities, like the Nimb ring, can be useful in the monitoring of elderly people living in the home environment (Tucker, 2017). The device adopts security capabilities and relays location at the press of a button, which could prove useful in emergencies, especially among the elderly living on their own. The device gets activated via bluetooth when the person wearing it moves beyond predetermined boundaries. This could also prove useful in elderly patients with Alzheimer's disease who are prone to wandering off. Since the devices use pre-measured information as a point of reference, once an activity that falls outside the normal boundary is detected, a signal

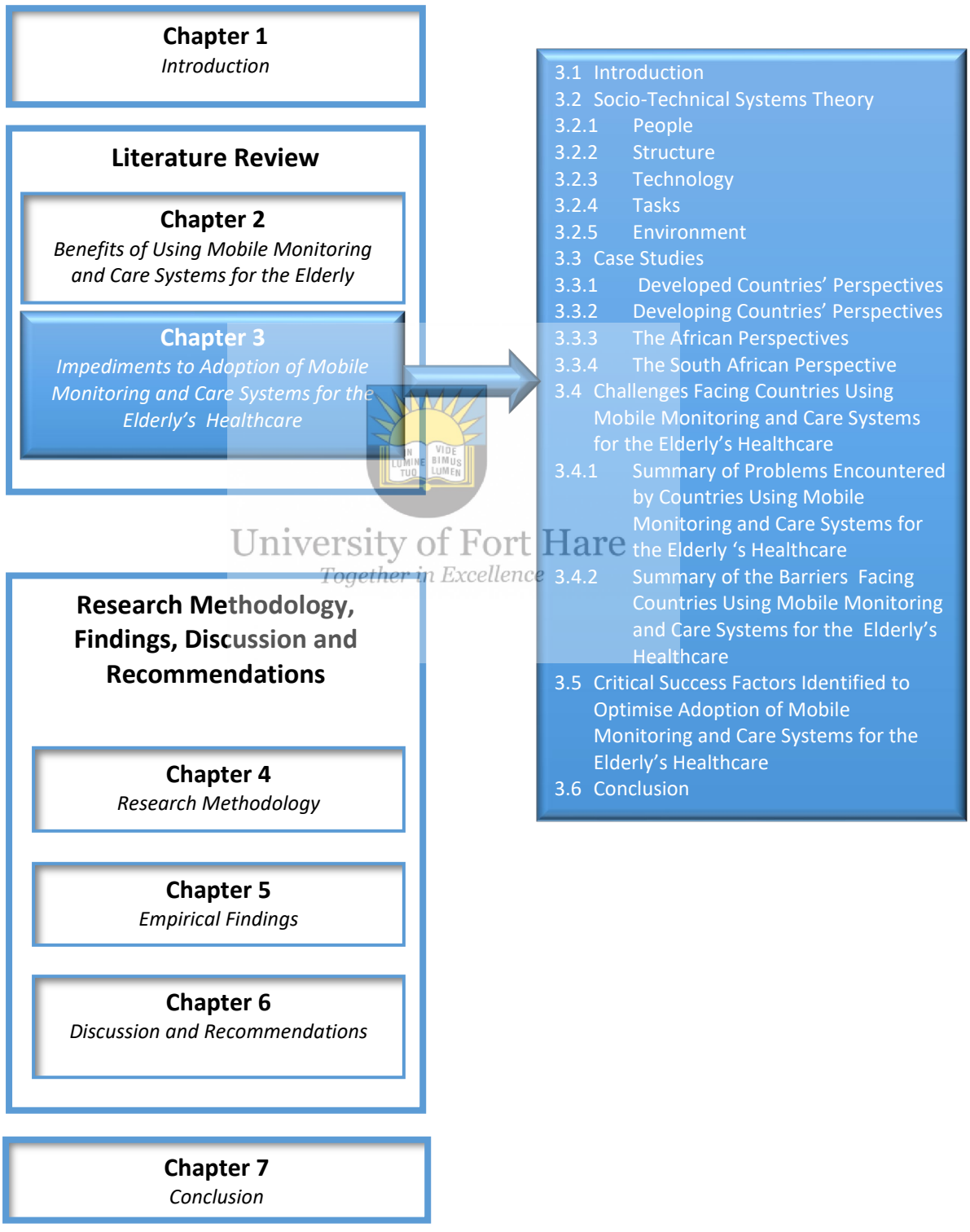
is relayed to the emergency personnel who monitor the data centre (Tucker, 2017). The dialogue of MMC systems cannot be complete without the inclusion of tele-medicine as a tool in delivering healthcare services, especially in developing countries (Adebesin et al., 2013).

Benefits of mobile technology include, but are not limited to, increased access to healthcare, reduced healthcare and related costs, improved response rate by healthcare workers, faster decision-making on healthcare, improved awareness about the elderly's healthcare issues, integrated healthcare systems, improved healthcare education and training initiatives. All these endeavours were aimed at improving health and providing the elderly with an enhanced quality of life. The use of embedded smart technology was one of the ideal platforms upon which to deliver better healthcare.

The successful adoption of MMC systems requires developing countries to take best practices from developed countries who have successfully deployed these devices for elderly healthcare. In addition, the perspectives of the emergency personnel and caregivers become pivotal in order to have a holistic approach to the elderly's healthcare dialogue. While there is available technology to enhance geriatric care, several factors impede the total adoption of mobile technologies for healthcare.

Despite the availability of the technologies and research on benefits of mobile monitoring and healthcare, there seems to be relatively few programmes offered by governments, especially to promote effective implementation strategies for elderly healthcare in developing countries (Mills, 2014). In order to facilitate an effective and efficient implementation strategy for healthcare, elderly people need to be part of all dialogue pertaining to their health (WHO, 2018). In Africa, governments' plans to improve the quality of healthcare for the elderly are tabled as part of the sustainable development growth plans as per Agenda 2063 (AU, 2015). The following chapter will discuss the identified impediments to adoption of mobile technologies for the elderly's healthcare and the proposed solutions thereof.

CHAPTER 3: IMPEDIMENTS TO THE ADOPTION OF MOBILE MONITORING AND CARE SYSTEMS FOR HEALTHCARE AMONGST THE ELDERLY IN THE HOME ENVIRONMENT



3.1 Introduction

WHO (2015) reports that elderly chronic diseases account for 60 % of global deaths. Europe has been attributed with the highest proportion of these deaths, accounting for 77% of chronic deaths of the elderly. It, therefore, was recommended that countries should find various means to reduce chronic diseases globally. The use of mobile technology was thus identified as an enabler to the recommendation. Most developed countries already have systems in place to facilitate elderly chronic disease management. Developing countries, however, face challenges in adopting mobile technologies in and for the elderly's healthcare. South Africa suffers from the global phenomenon of a rising elderly demographic, like the rest of the globe (WHO, 2015). The chronic shortage of institutional care facilities has resulted in many elderly people living at home (Ferreira, 2017). According to The Association for the Aged (TAFTA), this arrangement augurs well for the elderly people as the effects of home living may result in better social cohesion and communal benefits associated with familial engagement (McCallum, 2019). Farrell (2017) argues that when elderly people live amongst family and friends, they are more prone to adopt a pro-active role in their healthcare. Some of the benefits associated with living in the home environment relate to the use of healthcare technologies to alleviate the burden of healthcare among the elderly people (Mohammed & Safdari, 2014). Mobile monitoring and care (MMC) systems are some of the technologies identified for healthcare use by the elderly living at home (McCallum, 2019; Khalib & Ghalal, 2014; Lv, Xia, Wu, Yao & Chen, 2010). However, elderly people do not adequately use MMC systems to enhance the quality of their healthcare.

This chapter seeks to provide the barriers that impede the total adoption of MMC systems for healthcare by and for elderly people living in the home environment. The socio-technical systems (STS) theory was chosen as the fundamental framework upon which to base this study. The STS offer a system that seeks to examine the relationship between people and technology by exploring behaviours, attitudes and perceptions of people on using technology. The following section briefly discusses the constructs of the STS theory in order to contextualise the discussion that will follow later on.

3.2 Socio-Technical Systems Theory

STS theory was developed by Eric Trist, Ken Bamforth and Fred Emery circa World War II (Trist, 1981; Geels, 2004). The three authors were all founding members of the Tavistock Institute in London. According to Geels, (2004), the aim of STS was to measure the impact of

technology on efficiency and associated productivity in organisations. In Land (2000), it is argued that while the primary objective of STS was to measure the impact of technology on organisational efficacies, implementation problems emanating from employee resistance to change were also explored. In addition, Land (2000) further asserts that this resistance has a correlation to the failure of the organisation to achieve expected economic benefits. As a result, STS theory evolved and a fifth quadrant, environment, was later incorporated (Mumford, 2003). Ngowi and Mvungi (2018) assert that the use of STS becomes pivotal in the design aspects of mobile technologies that include the interaction between social and technical aspects. The following is an illustration of the theory Figure 7, followed by a contextual discussion of STS theory.

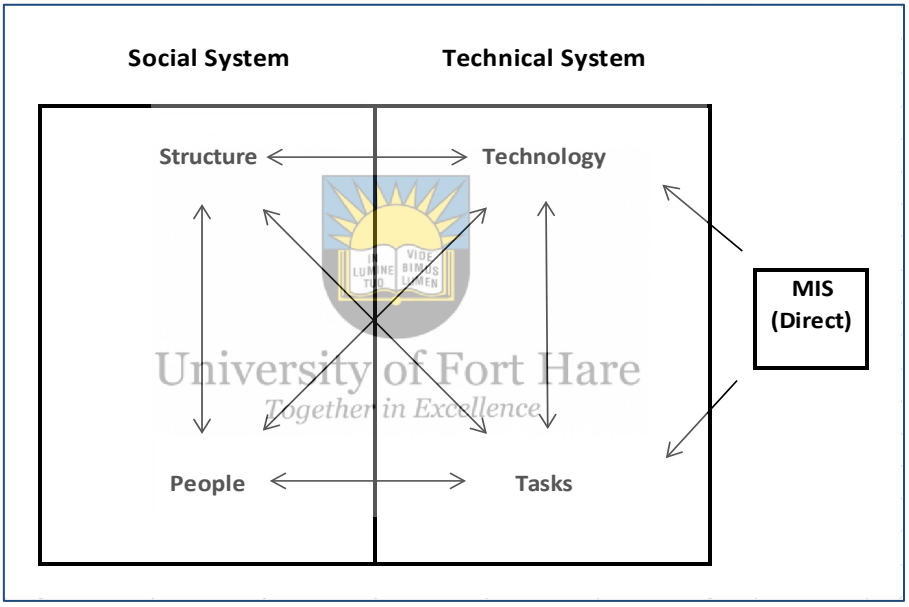


FIGURE 7: SOCIO TECHNICAL SYSTEMS MODEL (BONSTROM & HEINEN, 1977)

The STS theory has been adopted for many different areas of use in everyday life. Boucher (2013) adapted the theory for use in the health context. Figure eight provides an illustration of the contextualisation of the STS theory in the health care field.

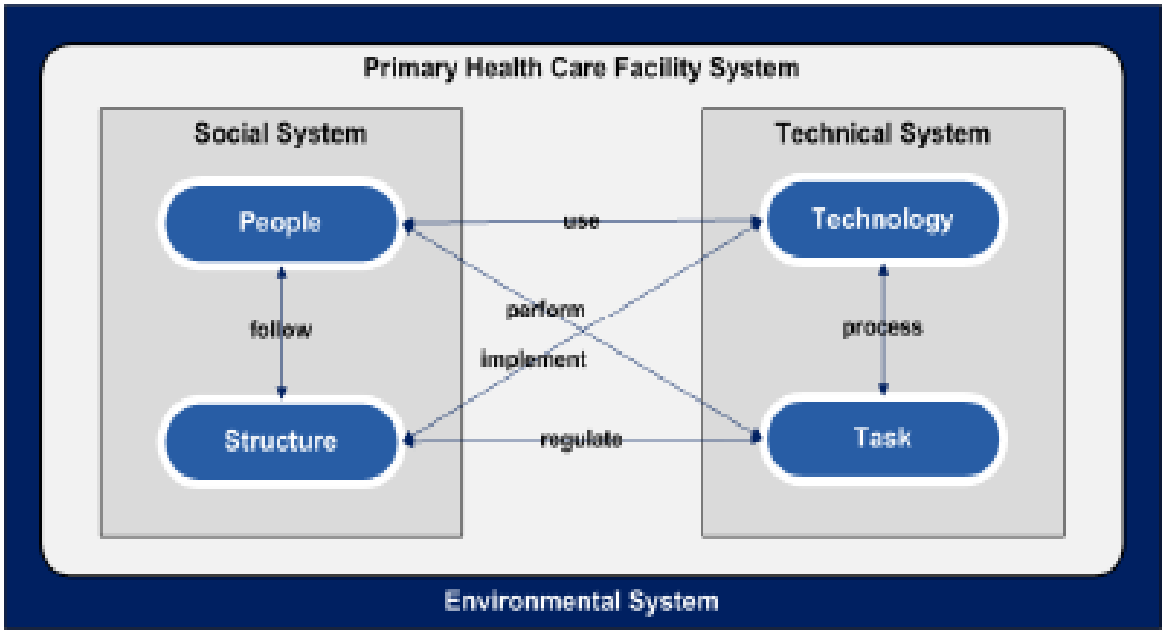


FIGURE 8: USING SOCIO TECHNICAL THEORY SYSTEMS FOR HEALTHCARE (BOUCHER, 2013)

3.2.1 People

In the people construct, the behavioural aspects pertaining to the relationship between technology and humans is explored. This construct will inform the study about how elderly people and healthcare workers use technology to improve the lives of the elderly living at home. This section also explores the behaviour emanating from resistance to change.

The second aspect addressed by the people construct relates to privacy concerns raised by the elderly living at home. Concerns about access to health information are discussed in this quadrant as found in Zeissig et al. (2017) and Rogers (1975), who identified four access barriers to adoption of technology.

3.2.2 Procedures

This construct will examine regulations affecting the use of mobile technology for elderly healthcare. In the procedures' construct, the necessary steps required to ensure a cohesive relationship between the population variables and technology are explored. In the context of this study, the level of awareness, education and training initiatives as well as the ease of use of technology by the elderly living at home and the healthcare workers will be considered. Research shows that when the tool used to deploy technology is better understood, the end goal of using technology will be easier to achieve (Almarashdeh, et al., 2018).

3.2.3 Technology

Since technology assumes a facilitative role, the technology construct will discuss the impact of technology on people, tasks and procedures. Challenges identified as impediments to the adoption of technology by the elderly people will also be discussed. These will include, but not be limited to privacy concerns; education and training levels; data governance issues; awareness, cost and affordability; and design issues affecting adoption of technology by elderly people in the home environment.

3.2.4 Tasks

The tasks construct will explore how the use of technology enables elderly people in the home environment to carry on with their daily tasks. Literature indicates that smart technology plays a positive role by encouraging the elderly to adopt a pro-active role in their healthcare (Gaba & Cilliers, 2014). In return, the burden on healthcare resources becomes minimal as the desire to use state resources diminishes (Ghalal & Khalib, 2015).

3.2.5 Environment

According to Baxter and Sommerville (2011), there needs to be a consideration of the environment in the STS theory framework. They further state that the environment could represent the cultural change that has become inherent in any system as the environment affects all the constructs in the STS theory (Baxter & Sommerville, 2011). In essence, user stories become important in the design of any social system (Whitworth, 2009).

Ngowi and Mvungi (2018) corroborate the inclusion of the environment and call for a people-oriented system as they believe that people are an integral part of any system. To strengthen their argument, Ngowi and Mvungi (2018) argue that there is a need for serious consideration of a pragmatic approach in the design of systems in order to offer a holistic service. According to Ngowi and Mvungi, the holistic offering should be inclusive of a flexible, people-centric, and value-adding system.

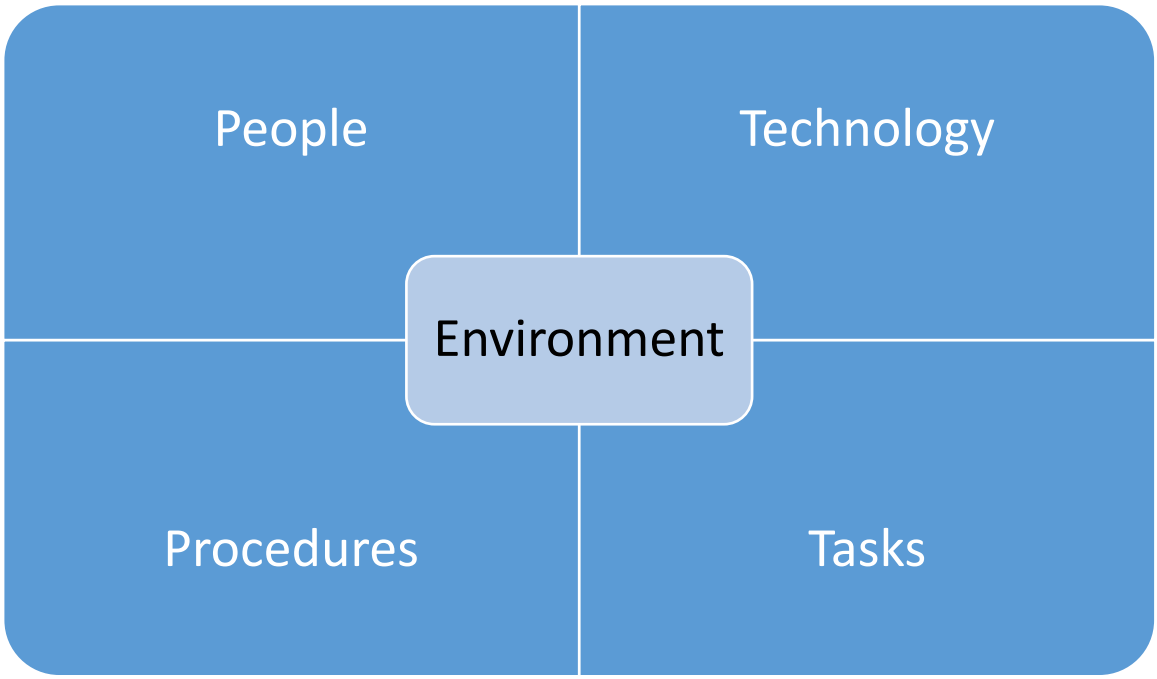


FIGURE 9: REVISED SOCIO TECHNICAL SYSTEMS THEORY INCLUDING THE ENVIRONMENT (NGOWI & MVUNGI, 2018)

Available literature on mobile technology for the elderly's healthcare attributes poor adoption rates to primary and secondary factors. Lack of infrastructure, affordability, lack of policy, lack of equipment and privacy concerns seem to be prominent factors affecting total adoption of mobile monitoring and care systems for healthcare. Developing countries appear to be the most affected, due to various prevalent socio-economic challenges per region. As a result, while the argument about the availability of mobile monitoring technology may hold true, for regions that do not enjoy the same privilege of accessibility due to geographical factors and local politics, the situation appears dire (WHO, 2015).

3.3 Case Studies

The following section is a discussion of the case studies that have been chosen for the purposes of this study. Developed countries like Canada, Sweden and Japan were chosen for the strategies they have adopted in dealing with the rise in numbers of elderly people. Jordan, India and Iraq were found to be the most suitable cases to provide the perspective of the developing countries. The African continent is represented by Tanzanian experiences and South Africa will be discussed as the final input.

3.3.1 Developed Countries' Perspectives

Canada enjoys a highly decentralised healthcare system with adoption of mobile technologies driven by the needs of the elderly population. Health agencies become enablers of these

population-based interventions; such agencies are actively involved in the identification, choice and thus suitability of mobile technologies used for the elderly's healthcare. In addition, the Canadian legislation allows for executive legislative buy-in on health policy issues. The consequence of the legislative buy-in has been successful early awareness intervention campaigns that led to increased state-funded housing centres for the Canadian elderly population who embrace independent living. Healthcare, social structures and economy are the major aspects of life that concern elderly people. This realisation has raised questions relating to the readiness of global governments towards an ageing society. There is evidence of resistance from the healthcare sector towards the use of technologies for healthcare (Chen, 2018). According to literature, Japan is one of the developed countries that have experienced an ageing population well ahead of other countries (WHO, 2015).

Chen (2018) asserts that Japan has a comprehensive healthcare system that is characterised by advanced technologies. The Japanese story started with the identification of problem areas at infancy stages of the population growth of the elderly. Various mitigation controls, like introducing mobile technologies for healthcare, were introduced. However, challenges that impede on the total adoption of mobile technology have been identified. These challenges pertain to geographical constraints that prevent access to eHealth by elderly people in remote and rural areas. In addition, Japan suffers from a shortage of healthcare workers (Chen, 2018). The shortage of healthcare workers is not unique to Japan. Developing countries like South Africa also encounter a similar problem, particularly worsened by a number of factors, hence the drive towards independent living (Quaglio, et al., 2016).

Sweden adopted smart technology to assist with remote monitoring of elderly patients with Parkinson's disease (Aghanavesi, Nyholm, Senek, Bergquist, & Memedi, 2017). The justification provided by the healthcare workers was that, to provide a comprehensive report of the patient's condition, the motor symptoms needed to be captured fully and not only on a once-off basis. According to Aghanavesi et al. (2017), the use of smart technologies assisted with assessments, decision-making as well as monitoring capabilities for the elderly people with Parkinson's disease in Sweden.

3.3.2 Developing Countries' Perspectives

In Jordan, an expert system for the elderly's healthcare (EHC) was specially developed to monitor the elderly in the home environment (Almarashdeh, et al., 2018). The EHC came about to aid to the socially and geographically excluded elderly people in Jordan. The system they

designed could be customised to the specific elderly person. The personalised intervention was made possible by using wireless sensor networks (WSN) technology. The EHC monitored diseases like blood pressure (BP), body temperature (BT), and heart beat rate (HR) with the use of server-side technology involving both the client and the server architecture (Almarashdeh, et al., 2018). Other systems that have been used include U-healthcare system design which include both WSN and RFID technologies (Caytiles & Park, 2014).

India developed a system to remotely monitor elderly patients with chronic diseases in order to alleviate their over-burdened healthcare system. The MMC system helps in investigating, monitoring and managing chronic diseases especially the prevalent type 2 diabetes, hepatitis B and HIV, especially in remote and rural areas. The Swasthya is a portable diagnostic mobile device that is used to record blood glucose, hepatitis B and HIV status from patients remotely. There are also 30 more diagnostic tests that can be performed by the device.

According to Saare et al. (2019), most older adults in Iraq have not adopted mobile technologies because of complex technical design aspects like user interface design requirements that do not satisfy customer expectations. Poushter (2016) supports the assertion made by Saare et al and adds that the lack of education and technical training exacerbate the issue of minimal adoption. Cultural constraints have also been identified as an impediment to full adoption of mobile technology by elderly people in Iraq. Technology adoption by the elderly is considered to be below 20 percent (Ghazal & Al-Khatib, 2015). In accordance with the STS quadrants, both the social aspects and technical aspects of the theory are more pronounced in the debate about adoption of technology by the elderly people in developing countries.

3.3.3 The African Perspectives

In Tanzania, medical personnel devised a healthcare system to alleviate the strain felt by their elderly population. This was done by introducing a mobile technological device for use in dermatology. An app known as First Derm is used to take photos of the skin lesions and sent to a dermatologist to confirm diagnosis before the patient is sent on a five-hour journey to Dar Es Salam; this makes the journey worthwhile when it is eventually taken. The use of this system allows the medical professionals in rural and remote areas to consult with the specialists in urban areas remotely. The social effects of this intervention are improved diagnostic and decision-making with reduced transportation costs for the elderly patient and the treatment of severe cases under minimal uncomfortable conditions.

Kenek O2 and Point of care ultra sound (POCUS) are some of the smart technology mobile devices available in Ethiopia. Since the major barrier in African countries seems to be access to healthcare, the development of mobile technologies can assist with bridging the gap. Emergency personnel and some medical procedures are made available remotely by using Kenek O2 and POCUS (White, Mayes, Byrne, & Mogg, 2016).

3.3.4 The South African Perspective

Despite the ubiquitous nature of mobile technology, South Africa faces numerous challenges largely due to the socio-economic challenges prevailing in the country. The risk factors associated with home living also warrant mention when addressing the elderly people's challenges in the South African context. Chiridza, Wesson, and Vogts (2019) allude to these risks as home injuries, home-environment-based risks and inactivity from unconsciousness state risks. The primary challenge facing South African elderly people is lower education levels among the elderly population, high data costs, cultural barriers and design constraints. As a result of the financial constraints, many elderly people do not have access to much needed mobile technologies that have monitoring capabilities, despite having access to mobile phones. South Africa is inundated with huge data costs which prevent access to health information (Rocker, 2013).

Intensive education, training and awareness initiatives are much needed interventions among the elderly people of South Africa in order to facilitate the adoption of mobile technologies. The diversified socialisation of the South African elderly population speaks to the challenge of social structures which do not enable the adoption of mobile technologies. Cultural aspects located within the social subset give rise to resistance in adopting mobile technologies as well as access barriers as identified by Zeissig et al. (2017).

The geographical landscape of the country exacerbates the situation as it is difficult and costly to reach rural and remote areas. To improve the adoption levels of MMC systems there needs to be urgent intervention from government to address geographic challenges experienced by elderly people. The use of MMC systems for healthcare can play a pivotal role in alleviating the burden currently felt by the overly strained health system in South Africa. However, lack of policy and frameworks to govern the use of MMC systems for healthcare impede the total adoption of mobile technologies for healthcare in South Africa.

3.4 Challenges Encountered by Countries Using Mobile Monitoring and Care Systems for the Elderly's Healthcare

While there is technology available for MMC systems for elderly healthcare, the adoption rate by elderly people is still considered low. Literature attributes the low adoption rate to primary and secondary barriers (Quaglio, et al., 2016). Primary barriers identified relate to poor infrastructure and lack of equipment, as well as affordability. Secondary challenges have been linked to access and geographical factors, and cultural inclinations in specific geographical areas. The other aspect associated with geographical constraints is availability (Malwade, et al., 2018). Some devices are only available in one country thus leaving the less fortunate with the challenge of access and affordability. As a result, various countries have started dialogues pertaining to improving the adoption of MMC systems for healthcare (Lunenfeld & Stratton, 2013). Quaglio et al. (2016) further allude to the lack of policy and regulatory frameworks as the factors that impede the uptake of e-health strategies for healthcare.

Another aspect affecting slower uptake of mobile technologies for healthcare relates to societal groups and healthcare systems (Papachristos, Sofianos, & Adamides, 2013). According to Papachristos et al. (2013), socio-technical systems have transitioned over time and the environment in which they operate, plays a significant role in technology adoption. It is further argued that in light of the perpetual growth of the elderly's population, the cost of healthcare services and the impact of rising healthcare costs need to be seriously considered. Therefore, societal needs of the elderly as they affect their societal groups should be factored in when making decisions about elderly people (Papachristos et al., 2013).

3.4.1 Summary of Problems Encountered when Using Mobile Monitoring and Care Systems for the Elderly's Healthcare

There are many obstacles for the elderly to make use of MMC systems in their home environment to increase the quality of their health care. The next sections provide a summary of these obstacles.

3.4.1.1 Affordability

Elderly people, especially in developing countries, can barely afford mobile devices for their healthcare since they depend on state age-old grants for their livelihood (Kasiram & Holcher, 2015). The MMC systems for the elderly's healthcare carry potential benefits to improve adoption levels by the elderly. However, the cost of mobile devices proves to be an inhibiting factor to improved adoption of MMC systems for the elderly's healthcare.

3.4.1.2 Design of Mobile Devices

The user interface design of mobile design is not considered user-friendly by the elderly people (McCallum, 2017). Although the elderly may understand how to operate the devices, a challenge ensues when they encounter user barriers in the form of small fonts used for texts and graphics. For the monolingual and literacy challenged folk, language sometime poses as a barrier as it becomes difficult to understand the content especially pertaining to instructions on the device (Balta-Ozkan, et al., 2013; Chen, 2018; Malwade et al., 2018).

3.4.1.3 Inadequate Technical Training

Elderly people, especially in under-resourced areas, have high illiteracy levels and this is a challenge that impacts on their technical ability. In South Africa, education was a privilege only suited to certain class types and individuals. The South African education systems were inadequately structured to address the technical needs of its then youth, the current elderly population (Morris & Hyslop, 1991; Kasiram & Holscher, 2015; von Fintel & Richter, 2019).

3.4.1.4 Data governance is not specific during data sharing

The lack of systems integration within the South African healthcare sector poses huge data threats for the sector. Elderly people question the manner in which their data is stored and shared. This ultimately raises data sharing concerns as there are no specific data sharing protocols due to the fragmented HIS, (Cassavia et al., 2016; Botha et al., 2015).

3.4.1.5 Lack of government intervention

The South African government is prone to adopting a blanket approach when dealing with issues around the elderly (Ferreira, 2019). This process-centric method cannot solve the plight of the elderly, especially in a diverse country like South Africa (Kelly, Mrengqwa & Geffen, 2019). Localised government interventions would yield better results as challenges affecting a particular region may not necessarily be the same in the other provinces, but are rather more suited to a concerted effort that will go a long way towards community-based interventions (Kasiram & Holscher, 2015).

3.4.1.6 Socio-economic conditions

The issue of affordability or lack thereof impacts heavily on the adoption uptake of MMC systems for the elderly's healthcare. While these mobile devices carry potential benefits for the elderly's healthcare, cost is a great impediment to accessing healthcare for the elderly people living in the home environment (Kasiram & Holscher, 2015). Behaviour, belief and attitude also add to the adverse impact of expensive healthcare which, in turn, may result in an increase

in the burden felt by the HIS currently (Kelly et al., 2019). It, therefore, becomes beneficial for government to develop community-based interventions that will reduce the socio-economic impact of expensive and unaffordable healthcare for the elderly.

3.4.2 Summary of the Barriers Facing Countries Using Mobile Monitoring and Care Systems for the Elderly's Healthcare

The next section provides an overview of the obstacles that developing countries face when implementing MMC systems for the health care of the elderly.

3.4.2.1 Affordability

Most elderly people claim that technology is costly for them as the majority of older adults are not part of the workforce and therefore unable to buy the mobile devices for their healthcare needs (White et al., 2016).

3.4.2.2 Exclusivity

This may be attributed to the design constraints of mobile technologies. Available technology rarely caters for exceptions, it is a "fit-for-all", gloved package that, when considered by someone in need, becomes useless because its general capabilities do not provide for their specific needs (Charness, et al., 2016).

3.4.2.3 Accessibility

In literature, it is argued that while technology may be considered ubiquitous and prolific, that may not be the actual case with elderly people. Many elderly folk cannot access technology due to a number of access-related barriers mentioned throughout the study (Zeissig et al., 2017).

3.4.2.4 Awareness

There seems to be a global phenomenon affecting most countries pertaining to the healthcare of the elderly. Literature alludes to a substantial amount of deficiencies relating to awareness by government stakeholders of the elderly's plight (WHO, 2015).

3.4.2.5 Inadequate education and training

There is much that needs to be done in terms of education and training about the elderly's issues globally (WHO, 2015). Until the dialogue concerning the gradual population increase is addressed and appropriate measures are taken to mitigate the effects of a rising elderly demographic, elderly people may still lag behind the revolutionary developments and possibilities brought by mobile technologies for healthcare.

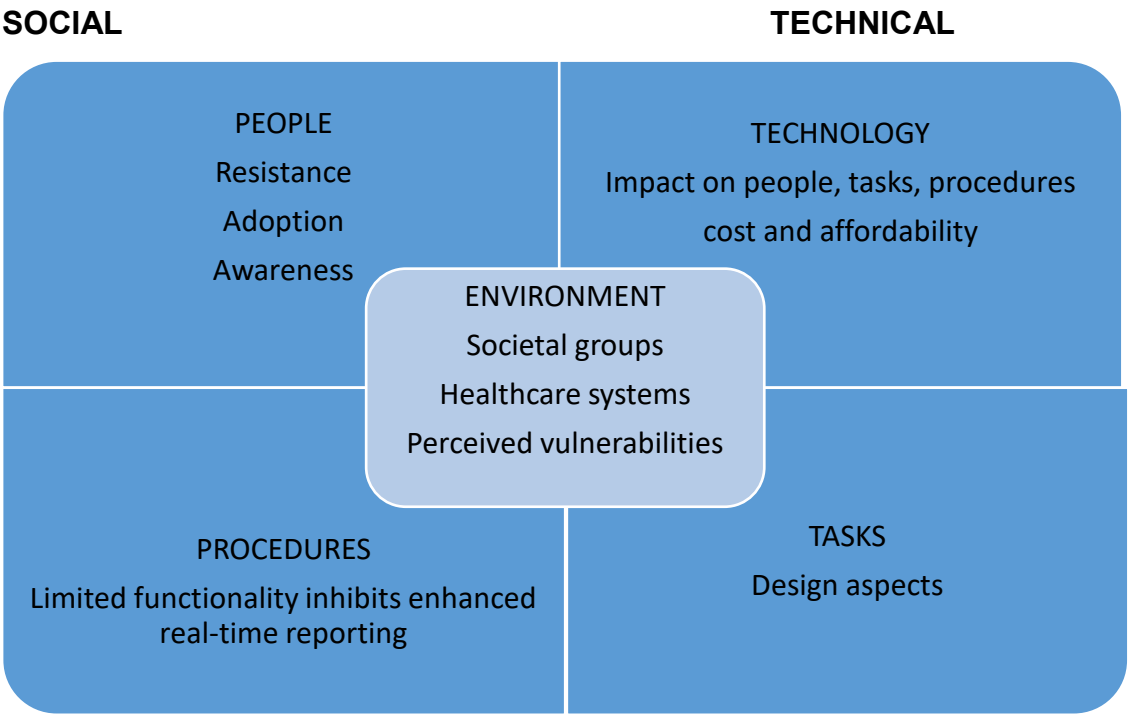


FIGURE 10: DEPICTION OF THE BARRIERS TO ADOPTION OF MMC TECHNOLOGIES (ADAPTED FROM NGOWI & MVUNGI, 2018)

3.5 Critical Success Factors Identified to Optimise Adoption of Mobile Monitoring and Healthcare Systems for the Elderly's Healthcare

Several authors assert that the proliferation of mobile technology will not be fully beneficial if the adoption uptake is not increased (Chiridza, Wesson & Vogts, 2019; Chen, 2018; Almarashdeh et al., 2018; Aghanavesi et al., 2017). Literature also indicates that there should be an intensive government buy-in globally pertaining to issues regarding the elderly (WHO, 2015). The following critical success factors (CSFs), discussed in the literature, were deemed to be the crucial factors that need to be seriously considered if the plight of the elderly is to be resolved:

- CSF1: Introducing a data governance framework for the elderly's healthcare
- CSF2: Improved access to ICT infrastructure
- CSF3: Integrated Health Information Systems (IHIS)
- CSF4: Cheaper internet costs
- CSF5: Intensive technical training
- CSF6: Living arrangements that enhance social facilitation in communities of elderly people

3.6 Conclusion

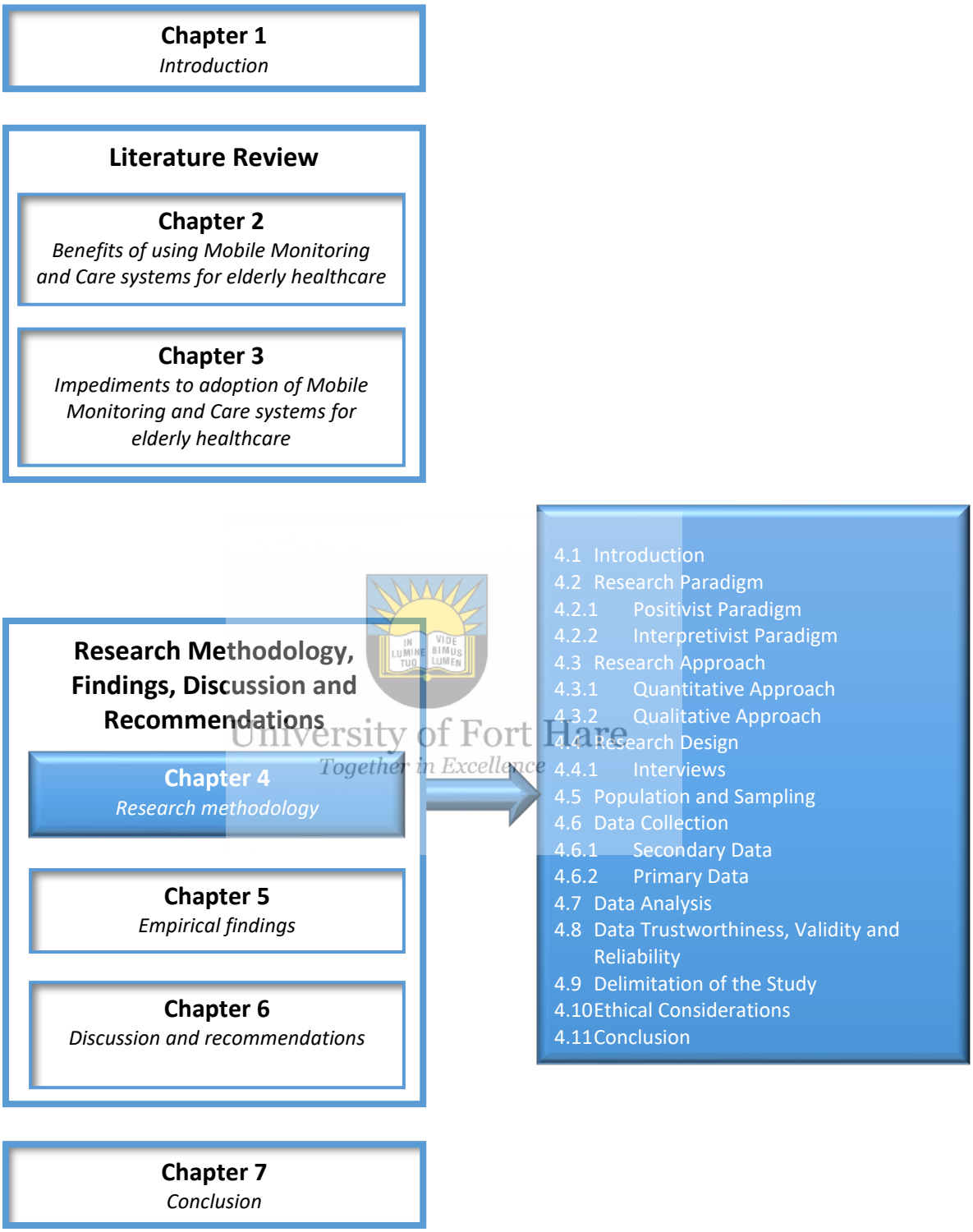
The increasing population growth of elderly people is a global phenomenon that can no longer be ignored. Several attempts by global governments led to the conclusion that the elderly's plight needs serious consideration and resolutions to improve their quality of life. These needed to be passed and adopted. It soon became clear that governments, especially in developing countries, were not ready for this exploding elderly phenomenon. Best practices and lessons learnt from developed countries were used to spring board innovations relating to the elderly's healthcare and enhanced quality of life. Mobile technology was one of the items identified to have the potential to revolutionise healthcare for elderly people globally. However, like any new development, that came with its own challenges as well. People are often resistant to change and this direction towards adoption of mobile technology was not immune to that. This study makes use of the STS theory to try and illustrate the challenges that impede the total adoption of mobile monitoring and care systems for the elderly's healthcare in the South African context.

The STS was developed by Eric Trist circa 1940 and was made up of two subsets and four quadrants. In later years, the environment construct was included as the fifth quadrant although its general role is considered to be overarching as it affects all the quadrants, namely, people, technology, tasks and procedures. The people's quadrant explores how technology is adopted and the resistance is encountered when it is developed and introduced. Privacy, trust and security concerns for the researcher's study were also discussed in this quadrant. The second quadrant sought to establish the effect of technology on the other constructs. Cost and affordability variables form a significant part of this discussion. Other challenges explored included but were not limited to exclusivity, accessibility, inadequate education and training initiatives as well as cultural and geographical constraints impeding adoption of mobile technologies for the elderly's healthcare.

The procedures' quadrant investigated how available technology was driven by regulation. It is reported that there are still major inroads to be undertaken for legislation pertaining to use of technology for the elderly's healthcare to be consolidated. As a result, South Africa suffers from a fragmented healthcare system that is not people-centric. One of the critical success factors identified was aimed at voicing concerns regarding legislation, particularly regarding the use of mobile technologies for the elderly's healthcare.

In the tasks' quadrant, issues relating to how the elderly use technology to prolong continuity of care were explored. It became evident in literature that mobile technology does indeed have positive effects on enhancing quality of life and healthcare for elderly people. Concerns relating to availability of qualified personnel were raised as it became apparent that there is a vast lack of skilled services and human resources in that area. The final component of the chapter came up with possible solutions to the plight facing elderly people in the form of six CSFs to improve adoption of MMC systems and thus alleviate the burden on healthcare resources for elderly communities living in the home environment.

Chapter 4: Research Methodology



4.1 Introduction

The fundamental aim of a research methodology chapter is to provide a map that will be used by the readers to navigate through the dissertation. Hence Hofstee (2006) argues that if the methodology chapter does not provide the reader with the requisite guidelines, then the likelihood of questions being raised regarding the validity and reliability of the conclusion of the study is higher. Research is about a shared viewpoint which needs to be validated to determine research rigour and credibility. To obtain research credibility, there are certain methods to which the research study is subjected. It is these methods that determine the kind of questions asked and they also explain the specific methods followed by the researcher in the study (Wilson & MacLean, 2011). Research methodology, therefore, refers to the logic applied in the research methods and the technique or a specific set of procedures used by a researcher to identify, select, process and analyse information about a chosen research topic, in following the applicable methodology (Rajasekar, 2006). The methodology used aims to provide a roadmap of how the researcher will conclude the study. The techniques that the study uses allow the reader to make a critical evaluation of the validity and the reliability of the study. Thus, questions relating to how data was collected and analysed are answered by the research methodology section.

4.2 Research Paradigm

A paradigm can be said to be an overarching perspective about a particular study (Antwi & Hamza, 2015; Cohen et al., 2000). The most commonly used paradigms in Information Systems research include the positivist, interpretivist and pragmatist approaches.

4.2.1 Positivist Paradigm

The positivist paradigm is rooted in objectivity where facts are considered, measured and tested to produce a deductive, quantifiable answer based on the facts provided (Cresswell, 1994). Hovorka & Lee (2010) and Alvesson, (2002) state that a credible researcher should reflect about the strengths and weaknesses of both the positivist and the interpretivist paradigms. In addition, the reflection of the researcher should recognise that both the positivist and interpretivist paradigms have strengths and weaknesses which are determined by the type of information the research study seeks to explore. Horvoka and Lee (2010) further argue that simply asserting that the research is positivist or interpretivist does not tell the reader much about the study. However, if these assertions are accompanied by the explanation (positivist)

and an understanding (interpretivist) then there could be more information that may be obtained to add to the existing body of knowledge.

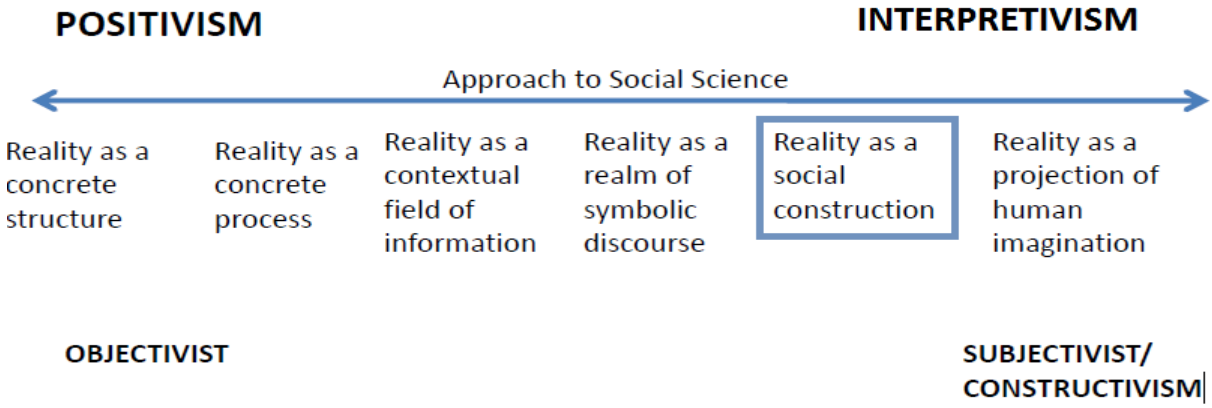


FIGURE 11: CORE ONTOLOGICAL PERSPECTIVES (COLLIS & HUSSEY, 2013)

4.2.2 Interpretivist paradigm

The interpretivist approach is based on human interpretation attached to the environment about which the understanding is sought (Lee, 2004). The subjective approach of the interpretivist paradigm explores human nature and will produce inductive inferences in line with how the researcher perceived the information at his/her disposal (Cresswell, 2014). Gray (2014) describes interpretivism as a cultural derivative of social reality, while Crotty (1998) argues that natural reality, which is associated with positivism, and social reality are different. Therefore, methods used in one cannot be the same for the other. In addition, the deductive inferences commonly found in natural sciences observe consistencies in available data, while social sciences are more concerned with the actions of the human being (Gray, 2014). The pragmatist approach makes use of both positivism and interpretivism and will not be considered for this study.

This study will make use of the interpretivist paradigm in order to fully explore the interpretations that will be made available after data collection. The interpretivist paradigm seeks to record human behaviour and attitude; it also seeks to understand how meaning is derived and interpreted in the observed environment. In this study, the research will interview the elderly to understand, from their perspective, the reasons they have for not adopting MMC systems to improve their own health care. Therefore, the interpretivist paradigm documents social reality as a meaningful inquiry that examines the complex phenomena inherent in human understanding (Creswell, 1994).

4.3 Research Approach

There are three research approaches used in research, namely quantitative, qualitative and the mixed method. Mixed methods research approach is the combination of the quantitative and qualitative data collection methods. There is a benefit attributed to using a mixed methods research approach: when qualitative and quantitative data collection methods are combined, the results provide a better understanding of a research problem than either research approach alone (Saunders, Lewis, & Thornhill, 2012). An example of a mixed method approach would be the triangulation method. When a researcher seeks to uncover unique dimensions of a phenomenon, triangulation is most commonly used. Triangulation can eliminate the bias that is possible when using a single method approach, thus amplifying the richness of the research findings. Since the purpose of this study is not to measure both quantitative and qualitative data, only the qualitative approach will be used.

4.3.1 Quantitative Approach

The quantitative approach uses facts as the premise of a study. The quantitative research approach is deductive in nature and will measure and test hypotheses based on the predictable behaviour presented by the data (Schroder, Carey & Venable, 2003). The structured approach found in quantitative studies makes it unsuitable for this study as the aim of the study is to understand behaviour, which can prove difficult to quantify or measure. Therefore, the statistical nature of quantitative research would not yield the expected results.

4.3.2 Qualitative Approach

Qualitative research methodology seeks to understand the research problem by exploring the environment. The researcher is allowed to probe the situation in order to derive meaning that will be later interpreted as the findings of the study (Schroder, Carey & Venable, 2003). The qualitative research approach is mainly focused on the insider's point of view and is therefore concerned with the process of understanding and obtaining meaning by documenting social reality. The qualitative nature of a research study seeks to record human behaviour in its natural habitat or setting (Merriam, 1988). The subjective, probing nature of a qualitative study makes it more suitable for this study in that it will provide the perceived interpretation from the rich landscape explored.

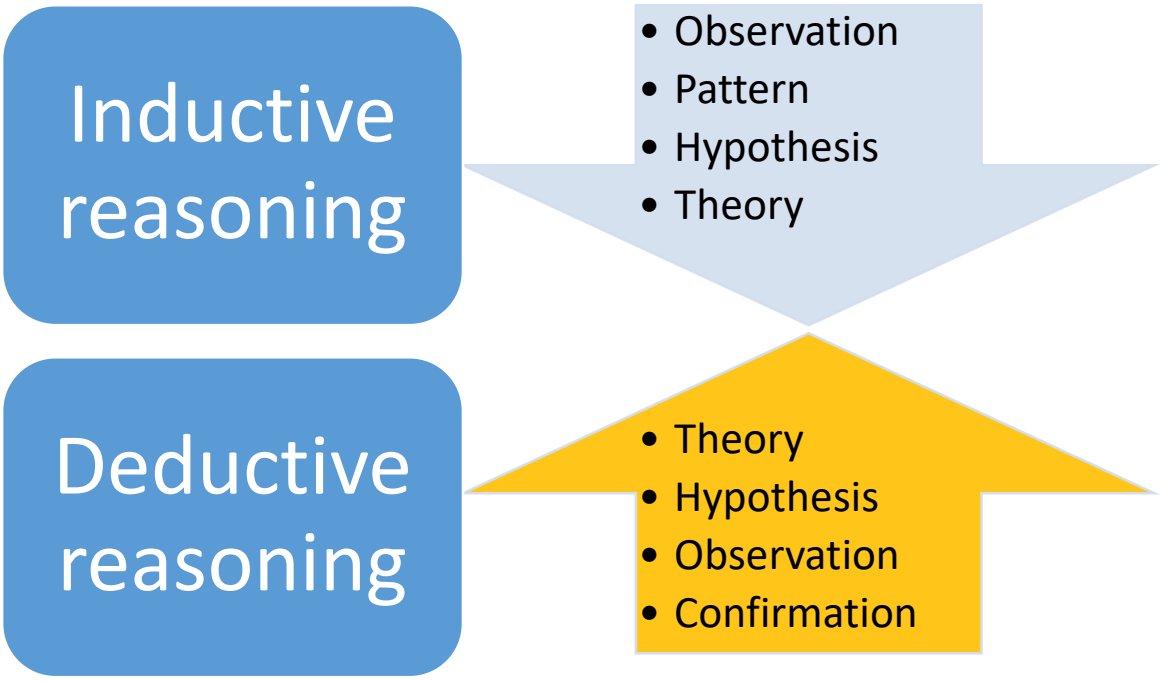


FIGURE 12: DIFFERENCES BETWEEN DEDUCTIVE & INDUCTIVE REASONING (COLLIS & HUSSEY, 2009)

It is common for qualitative research to be associated with inductive reasoning. This means that observations are generalised to past experiences and literature. Inductive reasoning allows the researcher to use information gathering methods like observation and in-depth interviews. Since the study is concerned with understanding and documenting social reality, an assertion can be made that it is indeed a qualitative study (Gray, 2014). The researcher observes the environment and looks for similar patterns to theorise about possible categories. It is from these patterns that the researcher will analyse available data to form themes during the analysis stage. The following table is an illustration of the differences between quantitative and qualitative approaches:

TABLE 1: COMPARISONS BETWEEN QUANTITATIVE AND QUALITATIVE APPROACHES (COLLIS & HUSSEY, 2009)

QUANTITATIVE	QUALITATIVE
Research process is deductive.	Research process is inductive.
Measurement is based on objective, quantifiable facts.	Social reality is documented and meaning is constructed (Constuctivist theories apply from observation of the environment).
The focus is on available variables.	In-depth meaning is the focus.

There is a firewall between the research process and the researchers' values.	The researchers' values are an inherent part of the study. Values of the researcher are present and explicit.
There is cross-contextual dependence.	There is contextual dependence.
Many cases are available for testing.	There are few cases available for testing.
Uses statistical analysis.	Thematic analysis is used.
The process is highly structured.	Uses a loosely structured research process.
Specific and particularistic.	Moves from a holistic perspective.
Separation from data, there is no intimacy with data.	The researcher has intimacy with data.
Generalises to the population.	Generalises to the population and context.

4.4 Research Design

There are several methods of research design and they include descriptive, correlation, explorative, experimental and semi-experimental methods. These research design methods also have sub-types aligned to each of them; for example, the sub-types of descriptive design methods are case studies and interviews. Since this study used interviews, the next section provides an overview of descriptive research design.

4.4.1 Interviews

For the purpose of this study, descriptive research design was considered to be the most suitable method since the study seeks to provide the analysis of a known research problem (de Vaus, 2005; de Vaus, 2001; de Vos, Strydom, Fouche, & Delport, 1998). Interviews were considered to be more appropriate for this study as human behaviour and interpretation was analysed to obtain an in-depth understanding of the environment under observation. The perceptions provided by the participants informed the findings of the study (Fletcher, 2018). Interviews were conducted until all the pertinent and relevant details about the research problem were brought to the fore. The aim was to provide a feeling of realism that was more representative of the research problem. This means the researcher aimed for a pragmatic approach in the interpretation of the interviews. Interviews are considered to provide a contextual and therefore meaningful interpretation of reality (Cilliers, 2017). Several questions were formulated as a guide for interviewing the participants. The socio-technical systems theory perspective was the grounding framework for the study.

4.5 Population and Sampling

All individuals of interest to the researcher are known as the population (Marczyk, DeMatteo & Festinger, 2005). A sample is a subset of the population that was chosen for the study (Engel & Schutt, 2013). Since it will be impossible to interview all the elderly people in South Africa, a sample was chosen to represent the population of the study. Thus, if something is true about the sample, it is likely to be true about the population as well (Marczyk, DeMatteo & Festinger, 2005).

A number of qualitative researchers make the deliberate choice of using purposive sampling in this type of research (Engel & Schutt, 2013). This is attributed to the fact that the sample is chosen for the qualities the people possess. However, purposive sampling excludes the reason for the number of the sample size. Since the Eastern Cape has high illiteracy levels, the chosen participants provided enough information to for the study. This translates to the elderly people whose living conditions increase their probability of using mobile monitoring and healthcare systems.

The population of this study was derived from one province in South Africa, the Eastern Cape, where the biggest population of the elderly resides (Statistics South Africa, 2018). The sample size consisted of elderly people from different socio-economic conditions and racial orientations living in their home environments. In the context of this study, the population consisted of 15 elderly people who are aware of MMC systems, even if they do not necessarily use them. These interviews were conducted until all the information that the participants had at their disposal was relayed. Purposive sampling has been chosen for its subjective nature, which allows the researcher to decide what needs to be known. This means that the participants have been deliberately chosen for the qualities they possess and may be able to provide the information as required (Etikan, Musa, & Alkasim, 2016) .

4.6 Data Collection

Data collection is a critical step of any research study. This study made use of primary and secondary data collection methods. Primary data collection refers to the process of gathering data at source to answer a specific research question (Hox & Boeije, 2005; Flick, 2018). The researcher did not rely on second-hand information only, but made deductions based on the participants' reactions at the time of the data collection. Secondary data collection refers to data that is collected for a different purpose, but that can be used to answer another research

goal (Hox & Boeije, 2005). Hence Lehmann and Bengart (2014) refer to data collection as a process of gathering information about the topic to be investigated using a systematic approach.

Data can be collected using different methods in both quantitative and qualitative studies and sometimes these methods may even overlap. The different methods can be classified into unstructured interviews, observations and secondary sources (Kumar, 2006; Gray, 2014). The crucial element that may act as the determinant of the applicable method lies in the application of the instrument or technique used (Kumar, 2006). Quantitative studies apply structure and standardisation to data collection, while qualitative studies usually have no pre-determined format thus allowing some form of flexibility (Kumar, 2006).

4.6.1 Primary Data Collection

Primary data collection refers to the collection of raw facts at source. In both quantitative and qualitative studies, this means that the data is newly available from the sample set that was chosen for the study. In research methods, this approach is used to obtain answers pertaining to the research question, testing hypotheses in quantitative research and evaluating possible outcomes (Lehmann and Bengart, 2014). As a qualitative interpretive study, this research will not be formulating hypotheses to be tested. This study made use of a qualitative, inductive approach to collect data from a series of interviews in order to obtain an in-depth analysis of the data collected from the sample (Appendix 3). The interviews were conducted until the objectives of the study, to understand why mobile monitoring and healthcare systems are not used by the elderly living at home, were achieved. Since the study is descriptive in nature, the socio-technical systems (STS) theory was used as the grounding theoretical framework. STS is mainly used to gain an in-depth perception about an identified problem in the environment (Trist, 1981). Primary data was gathered from the interviews, while secondary data was obtained from desktop research found in academic journals, books, conference proceedings, peer reviewed articles, Google Scholar, Research Gate, ACM Digital Library, PubMed, SAGE, EbscoHost, and Elserivier, which formed the basis of the literature review.

4.6.2 Secondary Data Collection

The concept of using available literature as a secondary data collection instrument is not a novelty. Secondary data collection refers to the use of available literature about the subject under study. The researcher used this information to verify that the data collected from the primary collection was corroborated, credible, validated and reliable. However, it should be noted that not all available data is acceptable. Relevance to the subject under study plays a

crucial role that will have an impact on the empirical stance of the research. In order to use secondary data that is acceptable and relevant, all the information gathered was supported by recent publications, and a few publications were used that supported recent literature. The following keywords were used for this research study: mobile monitoring and healthcare systems, elderly, adoption, home living, Buffalo City Metropolitan Municipality, Eastern Cape, South Africa.

4.7 Data Analysis

Data analysis is considered to be the most challenging aspect from a qualitative stance (Babchuk, 2019). The challenge assertion emanates from the lack of universally endorsed techniques to guide novice qualitative researchers. Several authors, who outline the data analysis technique, are depicted in tabular form below:

TABLE 2: QUALITATIVE DATA ANALYSIS TECHNIQUES

Merriam and Tisdell (2016)	Cresswell and Poth (2017)	Marshall and Rossman (2016)	Cresswell and Guetterman (2019)
Identifying segments of data responsive to research questions.	Managing and organising the data.	Organising the data.	Preparing and organising the data for analysis.
Category construction (Coding).	Reading and memoing emergent ideas.	Immersion in the data.	Initial exploration of the data through the process of coding.
Sorting categories and data.	Describing and classifying codes into themes.	Generating case summaries and possible categories and themes.	Using codes to develop descriptions and themes.
Naming the categories.	Developing and assessing the categories.	Coding the data.	Representing the findings through narratives and visuals.
Narrowing the focus (number of	Representing and visualising the data.	Offering interpretation	Interpreting the meaning of the

categories identified).		through analytical memos.	results through personal reflection and use of literature.
Becoming more theoretical (identifying levels of data analysis in qualitative research).		Searching for alternative understandings.	Conducting strategies to validate the accuracy of the findings.
		Writing the findings.	

Thematic analysis will be the technique used to analyse the data collected from the interviews. The use of thematic coding and analysis will assist the author to retrieve articles that have similar meaning at a later stage. Since the study seeks to bring about or to explore the reasons for a specific phenomenon, similar ideas or patterns will be identified and categorised to derive meaning that may result in answering the research question. In addition, relevance of the subject matter will be tested so that the findings of the study are relevant and usable. The data analysis of this study will make use of available data analysis software tools that are popular among qualitative data collectors.

4.8 Data Trustworthiness, Validity and Reliability

Trustworthiness in data involves data that is credible, transferable, confirmable and dependable. Qualitative data does not include the use of metrics to prove data trustworthiness, but the credibility, transferability, confirmability and dependability must be visible.

Credibility has been considered as one of the most important factors to establish trustworthiness. Credibility in data can be found when the evidence of true and accurate interpretation of the study's findings is available. One of the means to obtain data credibility is through the process of determining congruence by the participants who can confirm that the findings are a true reflection of their interpretations (Kumar, 2006). When the research study indicates that the instrument used to obtain the findings does demonstrate that the findings actually provide what the research study set out to do, then the research can be deemed to be valid (Guba & Lincoln, 1985). Credibility will also be established by conducting member checks. Member checks can be described as a process of aligning analysed data to data

collection by allowing participants to go through their interviews captured and verify that they are accurate and clean (Babchuk, 2019).

Data transferability can be demonstrated when data is subjected to other forms of data analysis techniques and still produces the same result (Trochim, 2006). Thus Trochim (2006) states that the degree of generalisation to other contexts will prove that data is transferable. Transferability of data refers to the generalisability of inquiry, which is the application of the findings to other contexts or with other participants (Nowell, Norris, White, & Moules, 2017). To ensure transferability in this study, detailed descriptions of the research process and findings will be provided so that any researcher wishing to use a larger sample from the population for a future study will be able to follow the steps to the letter.

Confirmability of data refers to the degree of confirmation by other researchers (Trochim, 2006). This means that the data analysed must be able to indicate neutrality in its findings. By so doing, data is considered confirmable and not biased to suit the collectors' viewpoint. Confirmability in a research study can be corroborated by other researchers only if the same pattern and process is followed (Cope, 2014; Trochim & Donnelly, 2007). An audit trail is usually used to provide the steps taken in coding and analysing the data (Olsen, 2004). The views of the participants will be fairly presented to ensure a balanced view of all beliefs, perspectives and values. To minimise the influence of the researcher's judgment, a confirmability audit will be conducted. A confirmability audit can be referred to as the technique used by the qualitative researcher to put into detail the data collection, data analysis and data interpretation methods used to ensure that the study is void of researcher bias (Korstjens & Moser, 2018).

Dependability in data can be observed from replication. If data is able to produce the same result when subjected to other methods in a similar manner, then it has proven dependable. This consistency may be applied by an external source as evidence of data dependability.

Cope (2014) argues that dependability can be achieved when a different researcher concurs with the decision paths at each stage of the research process, referring to the reliability of data over similar conditions. In this research study, dependability will be established by mitigating bias and ensuring the integrity of research data. A detailed explanation of the selected design, research process, and included instruments for data collection and analysis has been provided in Section 7.2 below. The next section discusses the delimitation of the study.

4.9 Delimitation of the Study

This study seeks to explore why elderly people do not adopt available MMC systems to alleviate the burden on healthcare resources. The study population will be limited to elderly people living at home in the Buffalo City Metropolitan (BCMM) area of the Eastern Cape (EC) province of South Africa. Only the elderly that lives at home (independently or with family), will be considered for the study. The next section will explain ethical considerations of this study.

4.10 Ethical Considerations

Ethics are described as a discipline concerned with that which is morally acceptable or unacceptable, right and wrong (Resnik, 2013). The ethical considerations of this study were informed by the guidelines contained in the ethical clearance certificate as per the proposal submitted to the Research Ethics' Committee of the University of Fort Hare (UREC). The basis of ethics is founded upon Belmont's three basic principles that guide research involving human subjects, namely, respect for persons; beneficence and justice. The following parameters were used to guide the ethical considerations of this study:

- Full disclosure: The purpose of the research study was explained to the participants during the interview request stage.
- Informed consent: The participants were given a full explanation of how the data collected from them would be used. The question of access to data was also raised.
- Voluntary Participation: Participants were made aware of their right to accept or decline the invitation to participate in the data collection process.
- Voluntary withdrawal from proceedings: Participants were made aware of their right to withdraw from the proceedings at any stage of the interviews.
- Anonymity: In terms of the PoPI Act (2012), all persons have the right to privacy. Participants were made to understand that under no circumstances would their personal identity or information, either in name or address, be exposed.

4.11 Conclusion

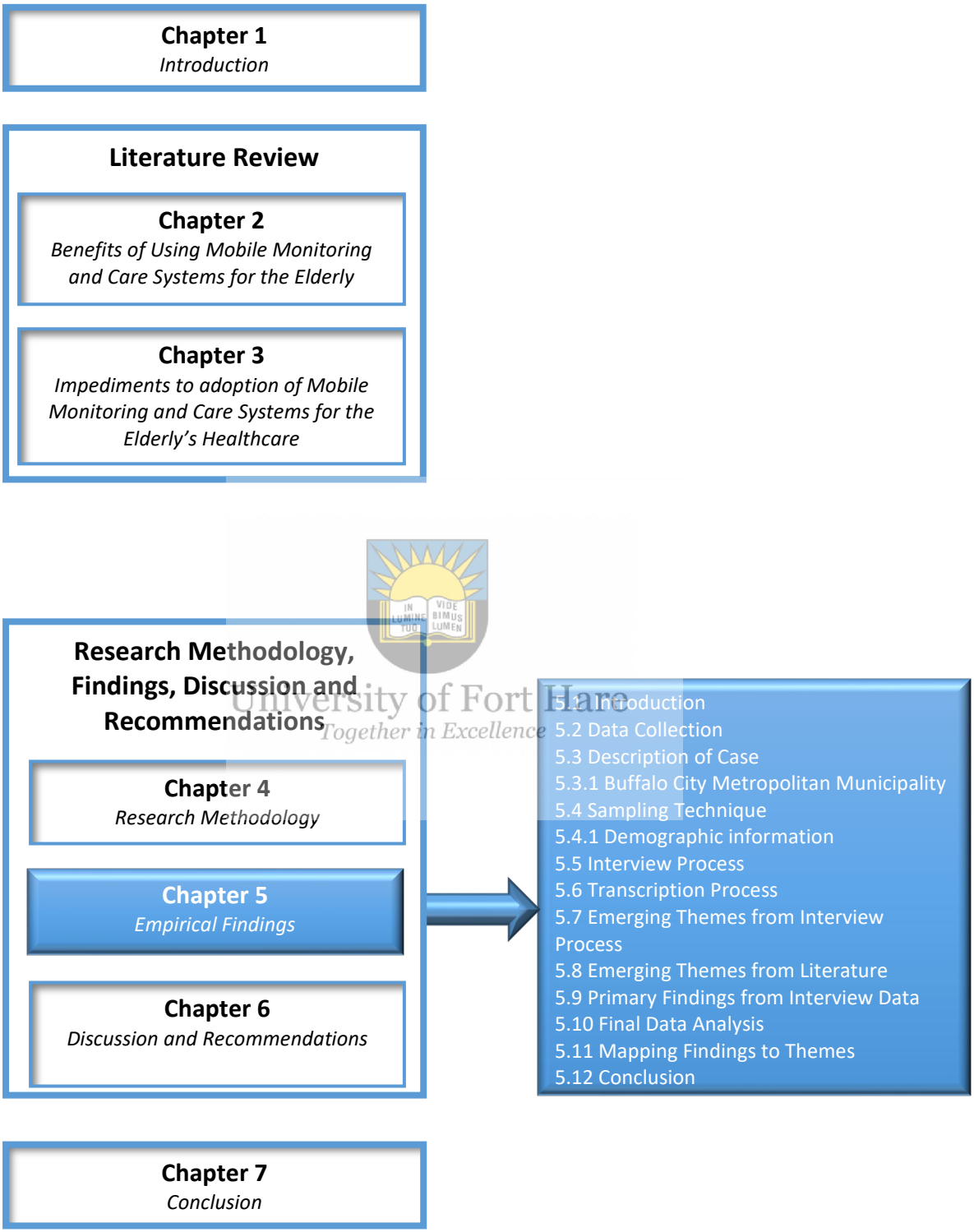
According to methodology scholars, research methodology can be referred to as the logic applied to the methods used in the development and delivery of information about the subject under study (Korstjens & Moser, 2018; Gray, 2014; Cope, 2014; Creswell, 1994; Hofstee, 2006;Rajasekar, 2006; Kumar, 2006). Schorlarly articles allude to a plan that needs to be

adhered to in order for the research to be considered valid. The plan of this study includes the use of the interpretive paradigm, which allows for understanding and interpretation of the environment under consideration.

The qualitative approach and associated appropriate design methods were deemed to be acceptable for the study at hand. It is reported that if the research design of a study cannot prove congruence and transferability, then that study may be deemed non-credible and not trustworthy.

The population of the study comprised fifteen (15) participants around the Buffalo City Metropolitan area through the non-probability sampling method chosen. Purposive sampling was considered to be the ideal sampling method as the purpose of the study seeks to explore the reasons why elderly people are not using MMC systems to alleviate the burden on healthcare resources. For the purpose of this study, the participants were chosen for the knowledge they have about available technologies as well the suitability of their living arrangements. According to StatsSA (2019) , the Eastern Cape is one of the provinces that has a high number of illiteracy rates among the elderly people and this resulted in the chosen figure selected to be interviewed. Interviews were chosen as the data collection method to be used for the case study. Interviews are considered more suitable with interpretive studies as they allow for probing (Creswell, 1994). The methods applicable for data analysis will involve the use of thematic coding whereby emerging categories from the transcripts will be grouped into themes. The researcher will facilitate a member check in order to prove the credibility of the study.

CHAPTER 5: EMPIRICAL ANALYSIS AND RESEARCH FINDINGS



5.1 Introduction

Based on the data collection instrument as described in the previous research methodology chapter, this chapter provide a detailed roadmap pertaining to data collection and the resulting analysis. The roadmap will thus incorporate participant perspectives of the elderly residents of BCMM, herein referred to as the sample, as well as offer the literature perspective. The aim of this study is to investigate the factors that impede adoption of mobile health monitoring and care systems by the elderly living at home. This chapter, therefore, seeks to illustrate the instruments used and analyse the results that were obtained during the data collection process. In relation to this process, the discussion of the results will be offered in Chapter 6. With the help of thematic analysis, the data collected in this study was analysed by developing themes from the data collected in order to derive meaning from it. The researcher did not rely on second-hand information, but made deductions based on the reactions at the time of the data collection. Secondary data collection was useful as a supporting measure to verify themes that emerged from primary data collection. Secondary data collection refers to data that is collected for a different purpose, but used to answer another research goal (Hox & Boeije, 2005).

Since the study seeks to bring about or to explore the reasons for a specific phenomenon, similar ideas or patterns were identified and categorised to derive meaning that may result in answering a research question. Through the analysis of data collected from the interviews conducted, supporting themes that emerged and were found to support emerging themes from literature review. These were compared and presented to provide research rigour and credibility. The objective of this study is to develop critical success factors that will improve adoption of mobile monitoring and care (MMC) systems for the communities of elderly folk living at home in BCMM.

5.2 Data Collection

Semi-structured interviews were conducted with 15 participants across BCMM in their living spaces. One participant was an employed elderly male. Two participants were employed elderly females. Twelve participants were elderly females surviving on an old age pension although a few received support from their families. Six of the participants came from affluent backgrounds, including the only male participant in the study. Another six participants were solely dependent on state old age grants and then there was one professional participant, well versed on healthcare issues, being a retired nurse currently working for a non-governmental organisation (NGO) for vulnerable groups.

The following sections will briefly contextualise the literature review and a description of the case including the participants' profiles. The subsequent section will then explain the interview process, emerging themes as well as a summary of the analysis. The emerging themes will be presented in comparative form to depict the relevance of the information based on the literature review conducted.

5.3 Description of Case

The BCMM is the amalgamation of Bhisho and two transitional local councils (TLC), East London (E.L) and King Williams Town (KWT). East London is the only river port town in South Africa situated at the Buffalo river mouth. It has a population of 755 200 people. In Buffalo City, elderly people comprise about 6% of the total population (Statistics South Africa, 2020). This translates to over 45 000 elderly people that mostly require healthcare and other social services from the government. Approximately 67.1% of the residents of Buffalo City do not have access to the internet. The elderly folk are dependent on the state old age grant for their livelihood. For those that want to practise independent living with peers, the grant is used to pay for board and lodging with little or nothing left to afford mobile devices for healthcare (Statistics South Africa, 2020).

5.3.1 Buffalo City Metropolitan Municipality

In 2000 the East London Municipality was established as a local municipality and formed part of the greater Amathole District Municipality (ADM). After the restructuring of local municipalities and demarcation rezoning, the former E.L. and KWT TLCs were separated from the Amathole District Municipality to form the then latest metropolitan municipality, BCMM, of South Africa on 18 May 2011. The Buffalo River runs across both former TLCs and it was therefore fitting that the new name assumed by the newly formed metropole would be named after the Buffalo River. The BCMM is bordered by KWT and surrounding areas on the West and East London and surrounding areas on the East. The three towns that comprise Buffalo City are East London, King Williams Town and Bhisho, covering an area of 2 536km², located on the East Coast of the Eastern Cape Province. The BCMM is home to one of the largest townships in South Africa, Mdantsane as well as three others, namely, Duncan Village, Zwelitsha and Ginsberg (Buffalo City Metropolitan Municipality, 2021). Seven rivers form catchments surrounding BCMM: Kwelera, Gqunube, Nahoon, Buffalo, Gxulu, Tylomnqa and Keiskamma River Catchments. According to the National Department of Water Affairs, the

BCMM falls within the Mzimvubu to Keiskamma Water Management Area. Figure 1 below is a graphical depiction of BCMM.

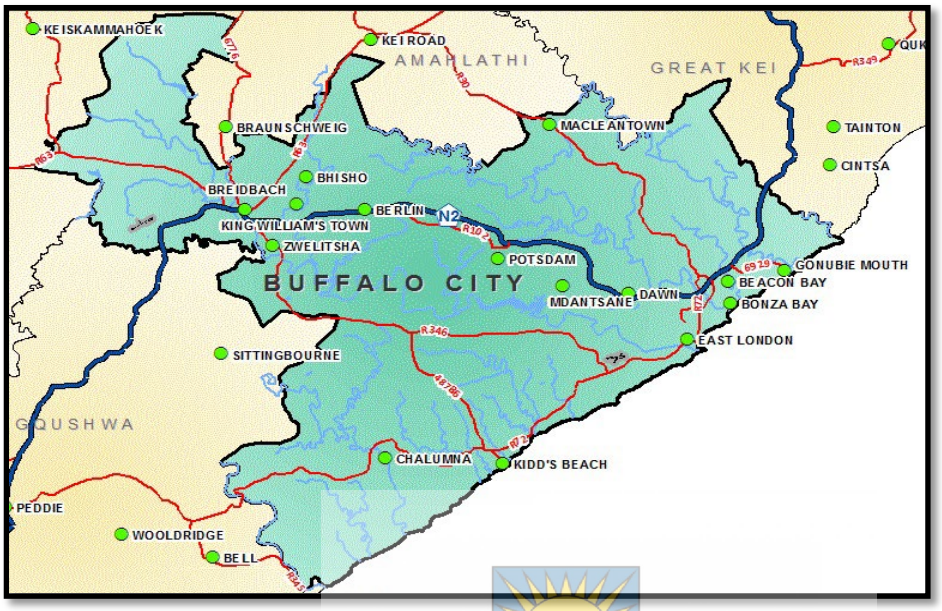


FIGURE 13: MAP OF BUFFALO CITY METROPOLITAN MUNICIPALITY (BUFFALO CITY MUNICIPALITY, 2020)

5.4 Sampling Technique

According to Etikan et al., (2016), the population of a sample refers to the subject(s) under observation in a research study. In the context of this study, the population consists of 15 elderly people who are aware of MMC systems, even if they do not necessarily use them. Users of MMC systems were interviewed to obtain a holistic perspective of the environment under observation. Since it is impractical to interview all the elderly people of BCMM, the sample size drawn was considered sufficient for this qualitative in-depth study.

As the study is purposive in nature, the participants were deliberately chosen to provide the information they have. This particular aspect will assist in proving the credibility, validity and reliability of the study (Kumar, 2006; Gray, 2014). Table 3 below depicts the sampling technique deployed by the researcher.

TABLE 3: TABLE TO ILLUSTRATE SAMPLING TECHNIQUE (OLATAIN, HERSELMAN & WAYI, 2017)

Data Collection Stage	Interview Process
Location in the Study	Chapter 5 (5.4)
Analysis of Participants	4 X Employed 11 X Pensioners
Relevance of Interview Process to the Study	The interviews were conducted to prove congruence with the main research question
Data Collection Mode	Interviews
Response Rate	100 %
Method of Analysis	Manual guided by ATLAS.ti constructs
Evidence	Interview Schedule, Confidentiality forms from ethical clearance

5.4.1 Demographic Information

The study sought to interview 15 participants who use mobile devices for healthcare purposes. One participant uses an MMC device for health enhancement. Two participants use mobile devices to obtain health information. Seven participants use MMC devices for health monitoring while five participants do not own mobile devices for healthcare due to lack of affordability.

During the interview process, it became clear that although some older adults were aware of mobile devices, they were not using them because of affordability issues. However, their opinion is included as part of the interview process as they were participants and contributed to the findings of the study. The following table describes the participants according to gender, age, marital status, ethnicity, religion, area of residence, level of education and employment status. The rationale informing the inclusion of this information was conceptualised during the literature review when culture was identified as one of the barriers to adoption of mobile devices.

TABLE 4: PARTICIPANT PROFILES

Participant	Gender	Age	Marital Status	Ethnicity	Area of Residence	Level of Education	Employment Status
1	F	>71	Widowed	White	Urban	Below Matric	Pensioner
2	F	>71	Widowed	White	Urban	Matric	Pensioner
3	F	>71	Married	White	Urban	Below Matric	Pensioner

4	F	>81	Widowed	White	Urban	Below Matric	Pensioner
5	F	>81	Widowed	White	Urban	Matric	Pensioner
6	F	<70	Married	White	Urban	Matric	Employed
7	F	>81	Widowed	White	Urban	Matric	Pensioner
8	M	<70	Married	White	Urban	Degree	Employed
9	F	>71	Widowed	Indian	Peri-Urban	Below Matric	Pensioner
10	F	>71	Married	Coloured	Peri-Urban	Below Matric	Pensioner
11	F	<65	Divorced	Black	Urban	Post-Graduate	Employed
12	F	>81	Widowed	Black	Peri-Urban	Below Matric	Pensioner
13	F	>60	Married	Black	Peri-Urban	Below Matric	Pensioner
14	F	>81	Widowed	Coloured	Peri-Urban	Below Matric	Pensioner
15	F	<65	Married	Black	Peri-Urban	Post-Graduate	Employed

5.5 Interview Process

The interview process adopted the semi-structured approach with probing employed to obtain in-depth knowledge about the question answered as per interview schedule (Appendix 3). Participant consent was obtained with the consent form signed by the participants. Participants were also informed of their right to withdraw from the interview. The researcher also informed the participants of their right to privacy and that their names would not be used anywhere in the research. The research participants were informed that the interviewer is bound by privacy and confidentiality clauses contained in the ethical clearance certificate, Appendix 1.

5.6 Transcription Method

The interview was conducted as per the Ethics' Research Confidentiality and Informed Consent form. Interviewees signed the forms as a means to give permission to the researcher to record the interviews. The researcher read out the consent form and explained the contents to the participants. Consent to take part in the research study was therefore voluntary.

The interviewer took notes during the interviews in addition to the recordings. This method allowed for the researcher to probe when the meaning was unclear. Although the participants mentioned their names, it was made clear during the interviews that their names would not be mentioned in the findings. The purpose of the above statement was to make sure that the participants understood that their answers would not be linked to them and no repercussions would arise from their participation.

The process of data analysis follows the critical stage of data collection. The complexity of data analysis becomes evident during the sorting stage as researcher bias can come to the fore and the reliability of the findings be subjected to scrutiny. The following figure is a graphical representation of the six-stage process developed by Braun and Clarke (2006) and corroborated by Creswell and Guetterman (2019).

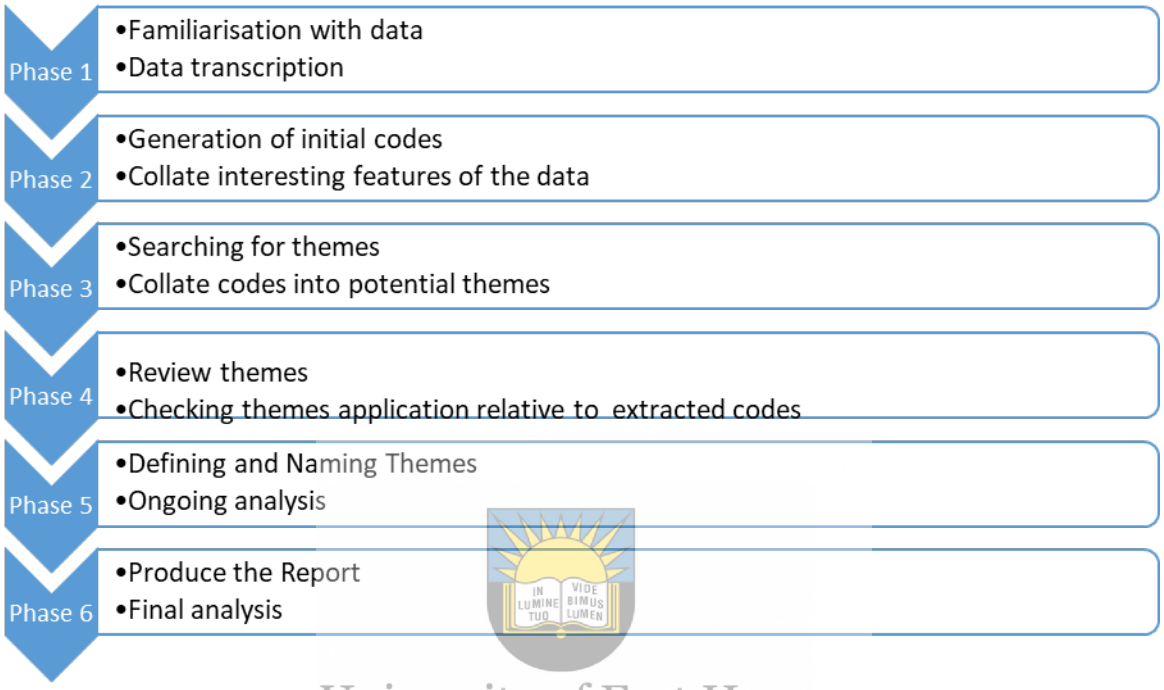


FIGURE 14: SIX-STAGE DATA ANALYSIS PROCESS (BRAUN & CLARKE, 2006)

5.7 Emerging Themes from the Interview Process

The analysis phase of this research was undertaken manually due to challenges beyond the control of the researcher. Thematic analysis provided the fundamental guidelines in terms of the analysis process. Thus, the researcher made use of coding as the point of departure during data analysis. Smit (2017) refers to coding as a lens that provides the researcher/interviewer with the ability to navigate through the data in order to capture the essence of the interview. Codes give rise to categories which eventually provide the themes analysed as the end product of data collection (Saldana, 2016). The following table is an illustration of the themes that emerged from initial data analysis. How these themes were identified will be illustrated in tables six to nine which is in the rest of the chapter.

TABLE 5: INITIAL EMERGING CATEGORIES FROM INTERVIEWS

PEOPLE CONSTRUCT	TECHNOLOGY CONSTRUCT
• Attitude, beliefs and perception • Technology anxiety • Minimal resistance • Intrusive nature of technology • Promotes social cohesion	• Value for money • Level of affluence • Cost of technology e.g. data costs
PROCEDURES CONSTRUCT	**TASKS CONSTRUCT**
• Government need to provide guidelines for standardisation of systems • Privacy and security issues due to lack of data governance	• Insufficient training • Design of mobile devices is not user friendly • Reduced burden on health care resources

Table five above depicts the initial categories that informed the themes that emerged from data collection. The structure of the table follows the socio-technical systems theory upon which the fundamental grounding of this study is based. Based on the above format, the table six seeks to illustrate the explicit views expressed by the participants during the interview process.

TABLE 6: EMERGING THEMES FROM INTERVIEWS

Statement Number	Corresponding Theme	Findings
4.1	Minimal Resistance (People construct)	There is minimal resistance displayed towards adoption of MMC systems for elderly healthcare
4.2	Technological anxiety (People construct)	Elderly communities not trained on using technology experience anxiety when faced with mobile devices even if they can enhance their health

4.3	Intrusive in nature of technology (People construct)	Some mobile devices are intrusive by nature and may lead to increased resistance
4.4	Affluence levels (Technology construct)	Socio-economic conditions prevent the elderly from acquiring mobile devices
4.5	High data costs (Technology construct)	Data costs impede access to both health care and healthcare information
4.6	Value for money (Technology construct)	Elderly people who use mobile devices find value for money from using MMC systems
4.7	Insufficient training (Task construct)	Both the elderly and healthcare workers seem to have inadequate training on the use of mobile devices for healthcare
4.8	Technology Anxiety: MMC training is cumbersome (People construct)	Elderly people who did not have technology training at an earlier age consider it cumbersome to learn at this late stage
4.9	Reduced burden on healthcare resources (Task construct)	MMC systems enable reduction of burden on healthcare resources
4.10	Government need to provide guidelines for standardisation of systems (Procedure construct)	Elderly people strongly feel government should take a more pro-active approach and provide guidance on how to standardise the system to decrease cost and acquisition

		of MMC systems for healthcare
4.11	Privacy and security issues due to lack of data governance (Procedure construct)	Data governance regulations pertaining to privacy and security standards run the risk of being flouted during data sharing
4.12	Attitude and Beliefs: Benefits of using MMC systems outweigh challenges (People construct)	The benefits of using MMC systems for the elderly's health care appear to be well received by communities of the elderly
4.13	MMC systems encourage social cohesion among elderly communities (People construct)	MMC systems encourage elderly people to assume a pro-active role in their healthcare
4.14	Design of mobile devices is user friendly (Task construct)	The interface of mobile devices excludes the elderly folk experience mobility issues

Table six has provided a high-level oversight of the various themes that were identified within each construct. Table seven now provides the explicit views from the participants that were interviewed for these themes. The number of participants that expressed this view is also provided in the last column. The quotes to support these explicit view are presented with the discussion in the next chapter.

TABLE 7: DEPICTION OF PARTICIPANTS WITH EXPLICIT VIEWS

Statement Number	Question Number	Findings	Number of Participants with explicit expressions
5.1	1	Elderly people are not averse to the adoption of MMC systems for healthcare (corresponds to 4.1 - Minimal Resistance)	8

5.2	3	Some devices with MMC systems are considered intrusive (corresponds to 4.3 - Intrusive in nature)	4
5.3	2	Elderly people who are not familiar with technology develop technological anxiety (correspond to 4.2 and 4.8- Technological anxiety)	11
5.4	5	Cost of technology prevents access to enhanced healthcare Related costs impede total adoption of MMC systems (correspond to 4.5 - High data costs)	11
5.5	6	Despite the challenge of cost, MMC systems offer value for money (correspond to 4.6 - Value for money)	14
5.6	4	Level of affluence determines access to MMC systems for healthcare (correspond to 4.4 - Affluence levels)	11
5.7	8	Privacy and security issues due to lack of data governance (correspond to 4.11 - Data governance not specific)	6
5.8	9	MMC systems reduce burden on healthcare resources (correspond to 4.9 - Reduced burden on healthcare resources)	11
5.9	10	Use of MMC systems is not standardised (correspond to 4.10 -	4

		Government role crucial e.g. standardisation)	
5.10	7	Training on using MMC systems is an imperative (correspond to 4.7 - Insufficient training)	15
5.11	8	Lack of skills impedes adoption of MMC systems for the elderly's healthcare (correspond to 4.7 - Insufficient training)	6
5.12	13	MMC systems for healthcare encourage elderly people to assume a pro-active role in their healthcare (correspond to 4.12 - Attitude and Beliefs: Benefits of using MMC systems outweigh challenges)	14
5.13	12	Benefits of using MMC systems outweigh the challenges encountered (correspond to 4.6 - Value for money)	11
5.14	13	MMC systems for the elderly's healthcare drive social cohesion (correspond to 4.13 - MMC systems encourage social cohesion among elderly communities)	11
5.15	14	The design of the mobile devices is considered not user friendly (correspond to 4.14 - Design of mobile devices is not user friendly)	8

5.8 Emerging Themes from Literature

The following section seeks to provide the themes emerging from literature as well as a comparative overview from the literature and data collection perspectives. The rationale

informing this technique is to show congruence between available data and literature. The end-result of this exercise is to show credibility, trustworthiness and validity of the study.

TABLE 8: EMERGING THEMES FROM LITERATURE

#	Emerging themes from literature	Supporting authors
1	Adherence positively impacted by adoption of mobile technology	Evans et al. (2016) Alves da Costa et al. (2016) Asano (2015) Kasiram and Holscher, (2015)
2	Mobile devices perceived to be intrusive in nature	Zainal et al. (2015) Mohammadzadeh and Safdari (2014)
3	Expression of privacy, trust and security concerns when PHI is shared	Zeissig et al. (2017) Kokolakis (2017)
4	PHI willingly shared when there is opportunity for financial benefit	Vandenberghe et al. (2018) Zeissig et al. (2017) Kokolakis (2017)
5	Technological anxiety manifests in elderly users	Murnane et al. (2015 Moon and Chang (2014)
6	There is displayed willingness to adopt MMC systems for healthcare	Sunyoung et al. (2016) Kasiram and Holcher (2015) Amlani et al. (2013)
7	Tele-medicine opening access channels for healthcare in remote and rural areas	Ovando et al. (2018) Sen et al. (2016) Conde et al.(2014) Ghazal and Al-Khatib (2015)
8	Socio-economic conditions in some elderly communities prevent access to MMC systems for healthcare	Ovando et al. (2018) Sunyoung et al. (2016)
9	Embedded technologies in healthcare systems offer hope to marginalised communities	Almarashdeh et al. (2018) Malwade et al. (2018) Tsang et al. (2018) Quaglio et al. (2016)

10	Cost of ICT infrastructure poses access challenges to developing countries	Malwade et al. (2018) Quaglio et al. (2016)
11	Security and confidentiality of PHI during data sharing procedures questioned	Charness et al. (2016) Siegel and Dorner (2016) Kokolakis (2017)
12	Privacy standards when sharing PHI not clearly defined	Kudzai and Cilliers (2016) Kokolakis (2017)
13	Lack of skills access are an impediment to total adoption of MMC systems for the healthcare of the elderly	Borelli et al. (2019) Almarashdeh et al. (2018) Malwade et al., (2018) Tsang et al. (2018) Aghanavesi et al. (2017)
14	Interconnectedness enablers of monitoring systems	Lv et al. (2010) Almarashdeh et al. (2018) Aghanavesi et al. (2017) Malwade, et al. (2018)
15	Health monitoring and tracking technologies reduce burden on health resources	Bowers (2020) Heath (2020) Lv et al. (2010) Almarashdeh et al. (2018) Malwade et al. (2018) Ghazal and Al-Khatib (2015)
16	Design of mobile devices like 'smaller is mantra' invoke exclusion of the elderly	Nikou (2015) Murnane et al. (2015)
17	MMC systems for healthcare encourage social cohesion in elderly communities	Maidment et al. (2016) Keidser and Convery (2016) Kasiram and Holscher (2015) Nikou (2015)
18	Appropriation of MMC systems offer relief to elderly communities	Vandenberghe et al. (2018) Maidment et al. (2016) Keidser and Convery (2016) Kasiram and Holscher (2015)

19	MMC systems for healthcare encourage better self-management among the elderly	Vandenberghe et al. (2018) Murnane et al. (2016) Nikou (2015)
20	Benefits of mobile devices for the elderly's healthcare influence acceptance and adoption of MMC systems	Chiridza et al. (2019) Lv et al. (2010) Vandenberghe et al. (2018) Ferreira (2017) Kasiram and Holscher (2015)

The next table, table nine, now combines the themes identified from the interview in table seven and the themes identified from the literature in table eight. For each corresponding theme, the identifiers in the various tables are provided in brackets.

TABLE 9: COMPARATIVE TABLE OF THEMES FROM LITERATURE AND DATA COLLECTION

Statement Number	Literature	Interviews
7.1 People construct	There is displayed willingness to adopt MMC systems for healthcare (correspond table 8, #6)	Minimal Resistance (correspond table 7, 5.1)
7.2 People construct	Technological anxiety manifests in elderly users (correspond table 8, #2)	Technological anxiety (correspond table 7, 5.3)
7.3 People construct	Mobile devices perceived to be intrusive in nature (correspond table 8, #1)	Intrusive in nature (correspond table 7, 5.2)
7.4 Technology construct	Socio-economic conditions in some elderly communities prevent access to MMC systems for healthcare (correspond table 8, #8)	Affluence levels (correspond table 7, 5.6)
7.5 Technology construct	Cost of ICT infrastructure poses access challenges to developing countries	High data costs (correspond table 7, 5.4)

	(correspond table 8, #10)	
7.6 Technology construct	MMC systems for healthcare encourage better self-management among the elderly (correspond table 8, #19)	Value giving (correspond table 7, 5.5)
7.7 Task construct	Lack of skills access are an impediment to total adoption of MMC systems for the healthcare of the elderly (correspond table 8, #13)	Insufficient training in healthcare workers (correspond table 7, 5.10)
7.8 Task construct	Lack of skills access are an impediment to total adoption of MMC systems for the healthcare of the elderly (correspond table 8, #13)	MMC training is not welcomed by those at an older age (correspond table 7, 5.10)
7.9 Task construct	Health monitoring and tracking technologies reduce burden on health resources (correspond table 8, #15)	MMC systems enable reduction of burden on healthcare resources (correspond table 7, 5.8)
7.10 Procedure construct	Interconnectedness enablers of monitoring systems (correspond table 8, #14)	Government need to provide guidelines for standardisation of systems (correspond table 7, 5.9)
7.11 Procedure construct	Privacy, trust and security concerns pertaining to data sharing have been raised Security and confidentiality of PHI during data sharing procedures questioned Privacy standards when sharing PHI not clearly defined (correspond table 8, #3, 11 and 12)	Privacy and security issues due to lack of data governance (correspond table 7, 5.7)
7.12 People construct	Benefits of mobile devices for elderly healthcare influence acceptance and adoption of MMC systems (correspond table 8, #20)	Elderly people are encouraged to adopt a more pro-active role for their health care (correspond table 7, 5.12)

7.13 People construct	MMC systems enable social cohesion among elderly communities (correspond table 8, #17)	MMC systems enable social cohesion among elderly communities (correspond table 7, 5.14)
7.14 Task construct	Design of mobile devices like 'smaller is mantra' invoke exclusion of the elderly (correspond table 8, #16)	Design of mobile devices is not user friendly and may lead to increased resistance towards adoption (correspond table 7, 5.15)

5.9 Final Data Analysis

The final data analysis process is expected to produce a report based on the developed themes that emerged from the primary data. The interview answers were organised as per the socio-technical theory quadrants in order to clearly enunciate the meaning as intended by the interviewed participants. This process was largely assisted by deploying probing questions and extensive note-taking during the interviews.

The data analysis stage will also indicate the specific answers and emphasis obtained from the participants. There will be a comparative analysis of the findings as some participants had opposing views to most. The views will be made part of the findings in order for the data analysis process to be representative. The results of the data analysis will then be presented in tabular form.

5.10 Mapping Findings to Themes

The following section is an illustration of the main themes emerging from the interviews and supported by the literature. The mapped themes indicate similarities thus providing the rigour of the study as shown in Table 10 below.

TABLE 10: INITIAL EMERGING CATEGORIES FROM INTERVIEWS

PEOPLE CONSTRUCT	TECHNOLOGY CONSTRUCT
• Attitude, beliefs and perception • Technology anxiety • Minimal resistance • Intrusive nature of technology • Promotes social cohesion	• Value for money • Level of affluence • Cost of technology e.g. data costs
PROCEDURES CONSTRUCT	**TASKS CONSTRUCT**

• Government need to provide guidelines for standardisation of systems • Privacy and security issues due to lack of data governance	• Insufficient training • Design of mobile devices is not user friendly • Reduced burden on health care resources

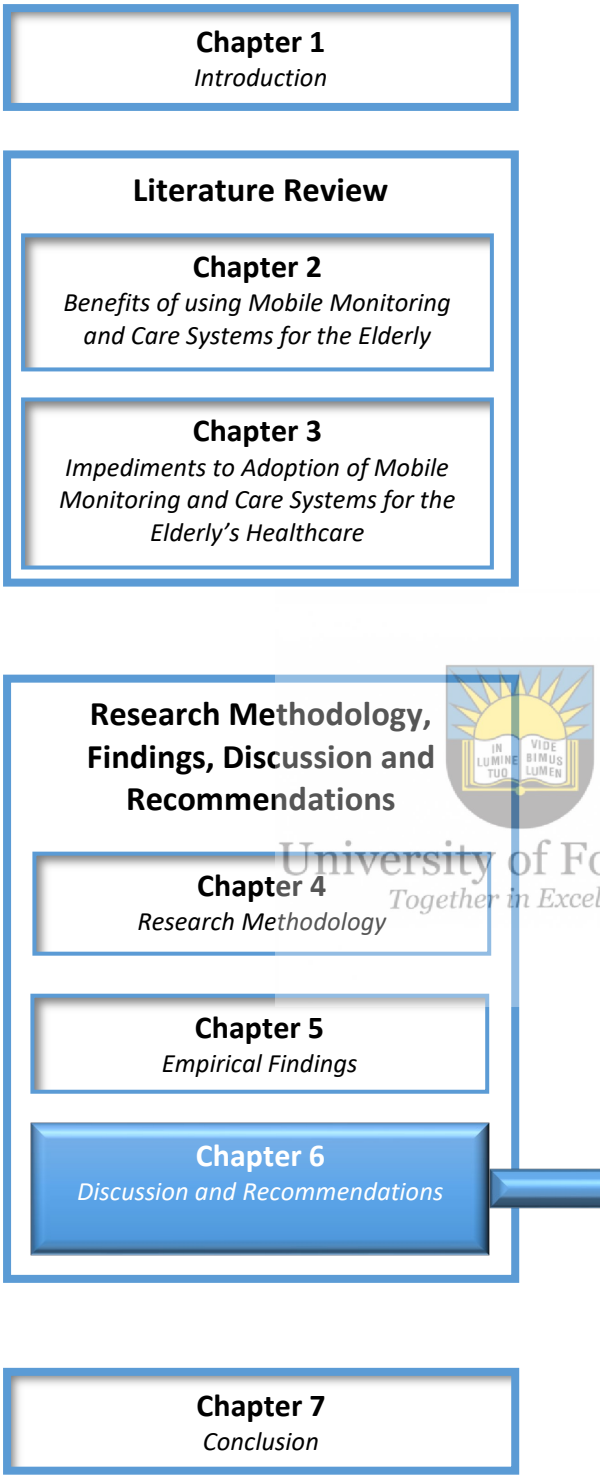
5.11 Conclusion

The objective of this chapter was to analyse the data collected from the interviews conducted with the elderly people living independently in their home environments. In addition to the data collected, a literature review was conducted to compare with the emerging themes. The perspectives of all participants were taken into consideration as they formed part of the sample.

The ethical methods, binding to the researcher during the interviews process, were described to the participants. The participants in return allowed the researcher to continue with the interviews by signing consent and confidentiality forms. The procedures followed have been detailed in the chapter. Some participants had an initial fear that since the interviews were recorded, there may be negative repercussions. Those fears were allayed at the beginning of the interview process.

The data analysis process followed a six-stage process starting with getting acquainted with the data during data transcription. Several phrases that were common in the interviews were picked up and organised. These were later used as codes from which the themes would be developed. The process of analysis was iterative. The final analysis of the study emerged from the themes using the interview questions and the fundamental theory as a guideline. The themes that emerged from the interviews were then mapped to the findings to determine congruency. These themes will then be discussed in Chapter 6.

CHAPTER 6: DISCUSSION AND RECOMMENDATIONS



6.1 Introduction

The aim of this study was to explore why elderly people living in the home environment do not adopt available MMC systems for their health care as these systems would alleviate the burden on healthcare resources and also improve the quality of their life. This chapter presents the findings from the interviews conducted with the research participants. The findings from the interviews are supported by the literature that was presented in previous chapters.

This discussion chapter attempts to answer the research questions formulated by the study and presented in Chapter One. Based on the congruency of the research questions and findings, the chapter then ends with the factors that may improve the adoption of MMC systems for the elderly living at home so as to improve their quality of life. These factors will contribute to the available body of knowledge on the subject matter and are the contribution of this research study.

6.2 Demographics

The 2019 MYPE reports that elderly people account for 9.1% of the South African population and this is in line with the previous projections about the elderly reported by Lehohla (2019). Gauteng still holds the highest number of elderly people with 24.1% residents aged 60 and above, followed by the Eastern Cape and Mpumalanga provinces. South Africa has displayed marginally low levels of research pertaining to the elderly in recent years and this resulted in the scarcity of pertinent information, especially of that relating to statistics around elderly communities (Ramocha, Louw, & Tshabalala, 2017).

Research into health disparities of elderly South Africans indicates an intergenerational transfer of health inequalities arising from the legacy of apartheid policies (von Fintel & Richter, 2019; Benatar, 2013; Barbarin & Richter, 2013). The effect of the inequalities becomes more evident especially when considering the fragmented HIS in South Africa. For elderly South Africans, availability of healthcare depends on affluency levels. To better understand the divergence of the public and private healthcare system, one would need to have a grasp of the quality of care afforded to 80% of South Africans using the under-funded public healthcare system and 20% South Africans who afford private medical care (Benatar, 2013).

The composition of the study participants consisted of 14 female participants and 1 male participant living in the home environment. This translated to 93.33 % female and 6.7% male participants. Reportedly, the majority of elderly South Africans live in their communities due

to a chronic shortage of institutional care facilities for the elderly (Kelly et al., 2019). The WHO advocates community living for the elderly because research has shown that when the elderly stay amongst their peers, they are more likely to receive a better quality of life and to be more physically active than their elderly counterparts in institutional care (Ramocha et al., 2017; Kelly et al., 2019).

The study comprised a sample size of 15 participants between the ages of 60 and 85 years. WHO (2015) describe elderly as all individuals aged 60 or more. The participant profiles were sub-divided into groups of four according to their age. Group 1 comprised the elderly from 60 - 65 years. This group constituted 20% of the participants. The following division was group 2 comprising the elderly between 66-70 years and consisting of 13% of the sample size. Group 3 was the elderly aged 71 years and over and was the largest group comprising 40% of the participants, while the last group consisted of the elderly aged 81 years and above at 27%. The study mostly constituted elderly females with only one male participating. It is believed that various factors including attitude, perception and belief; mental skills barriers; economic and social circumstances are cited as barriers to participation of elderly males in research (Kelly et al., 2019; Anderson, 2018; Ramocha et al., 2017; Akmatov et al., 2017; Attwood, Morton, Mitchell, Von Emmenis & Sutton, 2016). An in-depth investigation into the scarcity of male participants revealed that there are more female elderly South Africans than their male counterparts. The 2018 mid-year population estimates reported that nationally elderly females accounted for 10% more than their male counterparts of the South African population (Lehohla, 2019).

6.3 Mapping Themes to Socio-Technical Systems

Chapter three of this study introduced the social-technical systems (STS) theory. This section discusses how the themes from the interviews link to the STS theory. The STS theory comprises four quadrants namely people, procedures, technology and tasks. The people quadrant examines how the use of MMC systems can improve the lives of the elderly living in the home environment. The procedures quadrant discusses how the lack of standardisation in the healthcare sector adversely affects the quality of life of the elderly in the home environment. In the technology quadrant, the ensuing discussion relates to how affordability impedes the adoption of MMC systems for the elderly's healthcare. The tasks quadrant explores how the adoption of MMC systems for the elderly's healthcare carry the probable benefit of relieving

the strain felt by state healthcare resources and thus improve the quality of life of the elderly living at home.

There are thirteen themes developed by the study as can be seen from table 11. Five themes emerged from each of the people construct, two themes from the procedures construct, three themes from the technology construct and three themes from the task construct.

TABLE 11: INITIAL EMERGING CATEGORIES FROM INTERVIEWS

PEOPLE CONSTRUCT	TECHNOLOGY CONSTRUCT
• Attitude, beliefs and perception • Technology anxiety • Minimal resistance • Intrusive nature of technology • Promotes social cohesion	• Value for money • Level of affluence • Cost of technology e.g. data costs
PROCEDURES CONSTRUCT	**TASKS CONSTRUCT**
• Government need to provide guidelines for standardisation of systems • Privacy and security issues due to lack of data governance	• Insufficient training • Design of mobile devices is not user friendly • Reduced burden on health care resources

6.4 People Construct

In the social subset of the STS theory, there are two quadrants, namely, people and procedures. The following section discusses the themes identified during the interview process.

6.4.1 Minimal Resistance Towards Adoption of Mobile Monitoring and Care Systems

Very few participants displayed some form of resistance to adoption of MMC systems. The only male participant in the study displayed trust issues with technology based on a previous personal experience. Paradoxically, his mobile phone has a health app to help him avoid going to a monthly check-up and thus monitors his health issue using his smartphone.

"I don't really trust this technology talk, but if it means not going to the clinic, then so be it". (Participant 8)

During the interview process, it transpired that elderly people in general are not averse to adopting MMC systems to assist with their health care. However, the elderly conceded that there are factors to be considered that may hinder the adoption of MMC systems for their health care. Challenges flagged as possible hindrances to adoption of MMC systems for the elderly's healthcare were issues relating to affordability, information sharing and privacy. The elderly folk are affected by affordability issues as they impede their access to healthcare. In addition, the lack of education among elderly communities affects them and they involve themselves in the privacy paradox. Privacy in this context relates to the MMC systems which offer monitoring and tracking capabilities especially for frail elderly people.

"I wish I had enough money to afford these machines that check sugar levels so that I don't have to go to the clinic for monthly check-ups, the clinics are always full!" (Participant 14)

"Ever since my fall I have had a monitoring device in my bedroom because I live alone, sometimes it is burdensome because I no longer have full privacy, but my family lives far away and I rely on it for safety and for easy access to emergency help" (Participant 6)

The impact of a growing elderly demographic is increased strain on healthcare resources. Global governments, especially low-income and resource-constrained countries do not seem to have mitigating strategies to curb the upward trajectory of the elderly population. Elderly people also realise that governments are unable to fulfil all their healthcare needs and a dialogue pertaining to the elderly's needs has to transpire in the very near future. The willingness to adopt MMC systems for healthcare of the elderly is largely assisted by the benefits of using technology for the elderly's healthcare (West, 2015).

As previously mentioned in Chapter Two, the associated benefits of using MMC systems include, but are not limited to, enhanced accessibility, improved lines of communication, deployment of telemedicine in bridging the digital divide and improved interoperability in HIS. This has led to a change in attitude and perception and the elderly are now becoming more receptive to current technologies to alleviate the burden on healthcare resources (Sunyoung et al., 2016; Goll, Charlesworth, Scior, & Stott, 2015; Moon & Chang, 2014).

6.4.2 Technological Anxiety of the Elderly

Digital illiteracy is a global phenomenon that not only afflicts the elderly but other population groups as well. Illiteracy refers to the inability of an individual to read and write simple accounts of their daily life (UNESCO, 2020). Digital illiteracy refers to the inability of an individual to use, understand and perform tasks using technology (Felder, 2020). In South

Africa, literacy levels of the elderly were estimated to be at 72.1% in 2015, while the number of illiterate elderly South Africans was reported at 772,916 by (KNOEMA, 2020). It, however, should be noted that, based on available data, most of the information relates to Coloureds, Indians and Whites (Mariotti & Fourie, 2014). Reportedly, the effect of poor primary schooling has a huge bearing on illiteracy levels of the elderly (Aitchison, 2006). As a result of inadequacies in the national education system in the former dispensation, the South African elderly demographic is beset with the higher numbers of illiteracy, a fact that affects South Africa's development especially relative to healthcare issues (Gustafsson, van der Berg, Shepherd, & Burger, 2017).

While the elderly folk are reported to have increased literacy levels owing to education and training campaigns, health and technical literacy levels cannot be established. Literature alludes to an inadequate education policy that puts South African women at a disadvantage. Female South Africans who managed to progress with their studies were mostly employed in manufacturing factories as cheap labour (Barbarin & Richter, 2013). Other skills were reserved for the males in the country, including technical skills. Statistics South Africa reports that South Africa has a shortage of the technical skills set to counter the growing needs of the 21st century. Elderly South Africans are thus unable to perform most computer tasks and rely on assistance of family and healthcare workers for this function. This necessitates the implementation of intensive awareness drives in the youth of the country as a preventive measure for the future elderly population.

Elderly people develop technological anxiety when confronted with using new technologies (Attwood, Morton, Mitchell, Von Emmenis, & Sutton, 2016). Although this phenomenon is associated with the skills access barrier, it develops into the mental access barrier when the elderly refuse to use technology because they have developed a negative attitude towards it (Van Dijk, 2009). Participant 2 alluded to lack of education, especially for females, during their time at school.

"During my time at school there were no computers, only type-writers". (Participant 2)

Participant 4 reiterated the sentiments of participant three and corroborated that

"I was not allowed to join my brothers when they went to school, I had to stay at home because I was a girl. Girls were mostly trained at home to marry and be the best housewives". (Participant 4)

The inadequacies of the apartheid era have far-reaching consequences. This implies that the lack of technical skills training is a barrier for the elderly trying to accessing health care. Elderly people now struggle with using MMC systems that carry potential health benefits for them.

The elderly's lower adoption rate resulting from their lack of technical skills emanates from the inherent mistrust in the technology itself. The elderly, especially in developed countries with better health systems in place, argue that the onus to provide care using technologies and to learn how health systems work, falls on the healthcare workers (Vandenberghe et al., 2018; Akmatov et al., 2017; Murnane et al., 2015). In South Africa, the lack of mental stimulation to access technology is understandable because of the social situation that did not allow for female citizens to partake in technical education. Elderly people could benefit from learning how to use technology to improve their quality of life. Participant four reiterated this assertion and stated that:

"Learning how to use technology gives me a headache; that is why I do not bother. The nurses can read the instructions and help because they are more educated". (Participant 4).

This again implies that the elderly folk do not want to be bothered with learning technical skills as this induces the technological anxieties facing them in the event that they have to use MMC systems. The technical skills in this case relate to understanding the operational manuals that assist with the assembly and/or connection of their devices.

"My family in Gauteng says they do not have to worry about how to connect their devices, the devices come pre-installed". (Participant 13)

The interviews revealed that given a choice between using the device and not using it, the elderly would rather forgo the technological anxiety brought about by the inability to follow technical instructions and thus failure to assemble a device.

"I own a hearing aid, but I prefer not to use it because every time that I need to clean it, I become frustrated since I struggle with putting it back together". (Participant 4)

However, there is a paradoxical viewpoint in literature relating to the elderly with no mobility concerns versus those that do have mobility issues. In Charness et al. (2016), it is argued that text entry methods, like speech entry methods, can reduce technological anxiety encountered by the elderly when faced with using complex technical devices. Although the dialogue about including the elderly when developing mobile devices for their use has been started, there is still much that needs to be done by stakeholders responsible for elderly people's health and

welfare (Aghanavesi et al., 2017, (WHO, 2015). This is particularly important as it extends the mandate of the Madrid Plan of Action on Aging (2002) African chapter through the African Union Policy Framework on Plan of Action on Ageing (AUPFAA) (WHO, 2015).

6.4.3 Intrusive Nature of Mobile Devices Breach the Privacy of the Elderly

There is an assertion that mobile devices are intrusive for some elderly people (Mohammadzadeh & Safdari, 2014; Zainal, Ahmad & Razak, 2015). This assertion was also aired during the interview process.

The independence associated with using MMC systems for the elderly's health care is considered to be more valuable than the probable loss of privacy (Melander-Wikman, Faltholm, & Gard, 2008). Reportedly, this cost benefit analysis enhances and promotes self-determination and improved empowerment in elderly communities. The paradoxical view of the elderly regarding technology is appreciated and monitoring systems are considered a necessary evil but while privacy is compromised, the independence afforded by using the systems offers better prospects.

According to (Kokolakis (2017), the battle of choice in the privacy paradox war is mainly skewed towards the potential benefits. Although elderly people express a desire for privacy, once the benefits of relinquishing that privacy are known, privacy concerns quickly become a thing of the past. Kokolakis (2017) and Zeissig et al., (2017) attribute this phenomenon mainly to four issues: lack of knowledge about privacy; thirst for immediate gratification; an over-estimation of the actual benefits on offer and lastly, under-estimating the risks associated with information privacy.

The use of MMC systems for the elderly's healthcare also carries the challenge of privacy breach. However, privacy education may be used to mitigate the potential risks of using MMC systems for the elderly's healthcare. Even though elderly people felt their privacy was at times at risk, they understood this was necessary for their safety (Bowers, 2020; West, 2016).

"Sometimes I am wary about how the information I divulge on my app is used, but the knowledge that my health is under constant surveillance brings me and my family greater comfort". (Participant 15)

This is an example of the privacy paradox experienced by elderly people. While the monitoring in and of itself is considered intrusive, the benefit of receiving speedy medical response is welcomed (Kokolakis, 2017, Nikou, 2015).

These privacy challenges show that there is still much to be done in terms of managing privacy, trust and security concerns among the elderly. Elderly people who are aware of privacy and personal rights questioned the manner in which personal information is collected. This sentiment is shared in literary circles researching about data quality and data standards (Botha et al., 2015; Cassavia, Ciampi, De Pietro, & Masciari, 2016; Van Biljon & Renaud, 2016). However, some sections of the Promotion of Access to Information Act (PAIA) pose a challenge pertaining to access to information (DoJCD, 2017).

6.4.4 Mobile Monitoring and Care Systems Enable Social Cohesion

Elderly people who own mobile devices report an attitude change as they witness the associated benefits of using MMC systems for their health care (Pernencar & Romao, 2016; Nikou, 2015; Kasiram & Holscher, 2015). The associated benefits include less visits to health facilities, reduced transportation costs, remote consultations and monitoring, reduced social isolation as well as consistency in adherence. Participants 1, 2 and 3 lamented the lack of commitment from government regarding plans to provide holistic care for the elderly that is inclusive of social reform. Participant two observed:

"Government could assist us pensioners with mobile clinics to reduce visits to healthcare centres and then we would have extra income for other necessities". (Participant 2)

Affordability has been raised as an access barrier to adoption of MMC systems for the healthcare of the elderly and any extra income to the elderly affords them a chance for added living comforts that will enable social cohesion among elderly communities. Most elderly people have minimal technical skills according to some of the interview participants. The few participants that have more than average computer literacy skills indicated that being part of social networks provided them with companionship. Participant five who has a mobile phone that has a hearing enhancement application stated,

"Having this phone allows me to socialise and prevents embarrassing scenes when I am among other ladies". (Participant 5)

The hearing application allows the user to regulate the hearing without fidgeting with the hearing aid.

Other participants acknowledged the usefulness of the health information from their smartphones, but also complained about the size of the devices. Participant 12, with immobility

issues, relied on family to increase the font of the text in order for her to receive maximum capacity from the device.

"The phones would be great if they came with large fonts so we don't have to worry about reading from the screen". (Participant 12)

"My hands shake a lot and sometimes the phone falls because it is too small for me to handle". (Participant 13)

The current design of mobile systems is becoming smaller and this is a direct contradiction of the elderly's needs who have diminished capabilities as they grow older (Charness, et al., 2016). Nikou (2015) advocates for the adoption of MMC systems for the elderly's healthcare and makes the assertion that MMC systems offer support to changes associated with aging. In addition, there are other factors to be considered, like the social and psychology of inclusion and exclusion (Nikou, 2015) especially if the mobile technologies are adopted on time. While the early adoption of MMC systems by the elderly is advisable, careful consideration should be taken relating to the characteristics of mobile devices and their applicability to the elderly's healthcare and their well-being (Borelli et al., 2019; Charness et al., 2016; Nikou, 2015)

Despite the display of willingness to adopt MMC systems for the elderly's healthcare, until there are proper systems in place to improve adoption, the barriers in the environment still prevent access to healthcare by many elderly persons. Elderly people prefer the independence of living alone. There is, however, a danger associated with living independently. The MMC systems offer the benefit of reducing that danger through the monitoring capabilities offered by the available technologies. However, most elderly people in under-resourced countries do not afford MMC systems like monitoring, tracking and fall detection devices (Chiridza et al., 2019; Kasiram & Holcher, 2015).

Nikou (2015) argues that independent living by the elderly encourages social inclusion. Elderly people do not enjoy being burdensome and for this reason prefer living in independent environments. In addition, the socio-economic circumstances of the elderly in South Africa prove to be dire, due to region specific problems (Kasiram & Holscher, 2015). According to Chiridza et al. (2019), independence and safety are the key factors of importance to the elderly. The elderly folk have diverse needs and these increase with age. The South African legislation encourages community existence among the elderly as per the Older Persons Act (2006). However, the ailing healthcare system is an impediment to the realisation of the elderly's needs. Kelly et al. (2019) make the assertion that the most beneficial method to deal with the diverse

needs of the elderly is to adopt a multi-faceted approach that is not process-driven, but needs-driven.

6.4.5 Attitude, beliefs and perception of Mobile Monitoring and Care Systems

Proper tracking of illnesses amongst the elderly assists with improving adherence levels. Mobile devices like Accu-Check offer the elderly people with diabetes an opportunity to monitor blood glucose levels at home. Alarm systems and automated pill boxes in the home provide reminders to the elderly to take their medication. By taking medication at regular intervals, the elderly is preventing the need to constantly visit the healthcare centre. One of the advantages of less visits to the healthcare centre is a reduction in anxiety levels emanating from the time spent at the clinic or hospital. Participant 8 stated:

"I have reduced absenteeism levels at work as I can now monitor my vital signs on my own and only visit the doctor when it is necessary to do so". (Participant 8)

The MMC systems for healthcare offer convenience, comfort and accessibility to the elderly communities, especially to those living independently. As the elderly people are more prone to falls due to their unsteadiness and age, the monitoring, prevention and detection capabilities provided by the MMC systems allow for increased independence at home. It is this setting that allows for room towards higher adoption levels of MMC systems by the elderly. Although privacy, trust and security concerns remain, the associated independence is a greater commodity to lose.

The issue of adoption of MMC systems for healthcare is to a large extent adversely affected by the prevailing factors found in the environment. Given the increasing number of elderly people globally, governments should strive towards a paradigm shift aimed at concerted efforts to higher adoption rates by facilitating enabling environments in the geriatric space (Borelli, et al., 2019). The positive spin-off of increased adoption levels translates to a reduced burden on healthcare resources and the increased receptivity of the elderly to MMC systems for healthcare by deploying people-centric and less fragmented HIS.

6.5 Procedures Construct

The procedures construct falls under the social sub-set of the STS theory. In order to develop and improve the uptake of adopting MMC systems for the elderly folk's healthcare, there should be a multi-faceted and consultative approach where attitude and bias towards a

stereotypical lens is removed (WHO, 2015). The following section discusses themes identified during the data analysis stage.

6.5.1 Government Intervention is Pivotal to Standardisation of Mobile Monitoring and Care Systems for the Elderly's Healthcare

The elderly folk are a diverse population group and their health needs should not be resolved using a blanket approach. In addition, it is recommended that enabling environments should be created in order to encourage the elderly to be more receptive to MMC systems for healthcare (Kelly, Mrengqwa, & Geffen, 2019); (Western Cape Government, 2019). Some elderly people indicated their preference of owning MMC systems, but raised cost and digital illiteracy as impeding factors (Kasiram & Holscher, 2015). The onus for a conducive enabling environment for healthcare therefore falls on governments to improve adoption of MMC systems by the elderly living at home. If MMC systems are standardised, it will bring down the cost of the systems and allow interoperability between different brands or devices. At the moment the market allows for 'brand lock-in' where the elderly have to buy a specific brand because systems are not interoperable. If the elderly person decide to move to another brand due to cost or a larger selection of MMC systems, they will have to buy everything from scratch which can become costly.

Participants 1,2, and 3 all alluded to a need for government to contribute and provide some form of assistance to the resource-constrained elderly to access MMC systems for healthcare. Participant 1 suffers from diabetes and has to pay for medication as well as all other related expenses from her old-age grant.

"I would like to buy the machine that monitors my diabetes so that I don't have to visit the clinic every month, but all my pension money goes towards my daily living costs". (Participant 1)

Participant 2 complained about the transportation costs to visit the primary healthcare centre. In expressing her frustration, she made the following statement,

"It would be better if government could provide a community mobile clinic so that we do not worry about taxi fare which we sometimes do not have". (Participant 2)

Participant 3 suffers from muteness and relies on her friend to express herself. According to her friend,

"My friend needs more assistance from government because of her condition, sometimes she does not even have enough money left to buy her medication for hypertension since her needs are more than ours". (Participant 3, in translation)

She went on further to detail the challenges encountered by her friend. These challenges include sourcing additional assistance as she cannot speak and this was proving costly, especially since the friend depends solely on the age-old grant. These are examples of the diverse needs of the elderly living in the home environment. In their findings Kelly et al. (2019) corroborate this viewpoint and make the assertion that elderly people in low-income and resource-constrained areas are less responsive to the health system and argue that their needs are overlooked. The danger posed by this scenario is the increased likelihood of decreased adherence to treatment resulting in further pressure on already over-burdened healthcare systems.

"We would be better off if government could provide us with free medicines because all our pension goes towards our living expenses. (Participant 5)

The data collection process revealed that elderly people require the intervention of government to facilitate access to affordable healthcare. Elderly communities in under-privileged areas struggle to access healthcare due to a serious lack of ICT infrastructure and high technological illiteracy levels. Affordability is flagged as a major impediment to adoption of MMC systems for healthcare in elderly folks' communities. Government intervention is seen as lacking by the elderly who express concern regarding assistance that is not forthcoming from government. Non-governmental organisations (NGOs) play a role in helping the elderly, but their efforts are hindered by an inadequate funding system which only supports a few of the elderly communities.

6.5.2 Lack of Data Governance to Regulate Data Sharing Between MMC Systems Leads to Privacy and Security Issues

Data governance can be referred to as the consistent management of data in a manner that ensures confidentiality, integrity and availability through data authentication, access control and decision rights' procedures. The end goal of data governance is to achieve high data quality and thus faster decision-making (Knoppers & Thorogood, 2017). It is asserted that there are minimal data protection guidelines for sharing personal health information, especially in developing countries like South Africa (Cassavia, Ciampi, De Pietro, & Masciari, 2016; Botha et al., 2015). Elderly people expressed concern at how their PHI is shared when collected during monitoring and tracking on the mobile devices. Data concerns relating to access, as raised by

some participants, led to the conclusion that there is very little awareness about data governance during data sharing especially given the fragmented HIS in South Africa. Data governance researchers attribute data sharing concerns to a lack of data policies and data standards for most health systems (McNeill, 2019; Cassavia et al., 2016).

"I noticed that every time I use my health app., I would receive messages about available products, is that even allowed?" (Participant 11)

Elderly people provide personal health information at healthcare, but there could be data integrity and data quality issues. According to literature, data governance is not prioritised by the healthcare sector, mainly because of cost and existing digital limitation (Iyamu, 2020). (Lupi, 2019) advocate the use of data analytics to assist the healthcare sector with the vast amounts of big data. However, it is noted that a data governance framework (DGF) for the healthcare sector may provide health legislators with guidelines regarding data collection, sharing and storage to ensure that data integrity is maintained and conforms to the confidentiality, integrity and availability prescripts (Lehohla, P, 2019); Lupi, 2017). Currently, the South African healthcare sector is more susceptible to data breaches since the health information systems (HIS) are fragmented (Pinnock, B, 2020). The reported fragmentation may have adverse effects on the elderly who prefer to spend less time in healthcare centres, according to Participant 7.

"When they realised I was not on medical aid, I had to go to Frere Hospital where the same blood tests were performed. I thought all hospitals had the same information. I was very agitated!" (Participant 7)

"I visited another hospital in Cape Town and before I could see a doctor, I had to give information all over again. Apparently, I was supposed to bring my previous blood results with me because the Cape Town hospital doesn't have the same system as Frere Hospital in East London. Whose problem is that?" (Participant 9)

These are examples of the complaints that came up during data collection. This implies a fragmented HIS that adds to the anxiety felt by the elderly when visiting healthcare centres. To avoid the anxiety induced by prolonged hospital visits by the elderly in the home environment, government could embark on intensive data monetisation for the healthcare sector.

In terms of the DGF, there are five components that constitute the data governance stakeholders. The core components of data governance stakeholders include (i) data owners or

sponsors, (ii) data stewards or champions, (iii) data custodians, (iv) data governance committee and (v) data governance team. The data governance team usually comprises the manager (master data governance), solutions and data governance architect, data analyst and data strategist. The main mandate of the data governance committee is approval of data policies and standards. The implementation of a DGF in the healthcare sector ensures data integrity, reduced data infringements, and patient safety. Data digitisation in the healthcare sector may bring increased complexity and diversity, but the end goal is improved data quality, data protection and sound data policies and standards for the healthcare sector. According to the protection of personal information act (PoPI, 2013) protection of personal information is a fundamental human right. The likelihood of data infringement is higher when data sharing guidelines for using MMC systems for healthcare are not explicit (Botha et al., 2015).

"I think our health information is sold by the clinics because I got a call from someone who wanted to ask if I did not want to live at an old age home because of my condition. How did they get my information because I did not give permission for that and we have someone in our community that calls on us on a weekly basis." (Participant 14)

Data collection revealed a disconnect in data sharing between public and private hospitals. Public hospitals operate in silos, which leads to a duplication of processes. The issue of standards in the healthcare sector involves using big data due to the vast amounts of data consumption within the sector. The challenge faced by healthcare workers and the elderly revolves around the digital divide. Research indicates a significant lack of digital literacy in both the elderly and healthcare workers. Data integrity becomes a serious concern from a privacy and security perspective, in the face of folk lacking digital skills. Factors relating to disclosures and patient information sharing are red flags when the digital divide and digital literacy prove a challenge (Abouelmehdi, Beni-Hissane, Khaloufi & Saadi, 2017; Knoppers & Thorogood, 2017).

This discussion corroborates available literature on trust and security concerns raised by the elderly (Chiridza et al., 2019; Vandenberghe, Vanhoof, Voorend, Geerts & Dobbels, 2018; (Zeissig et al., 2017); Kudzai & Cilliers, 2016; Kasiram & Holscher, 2015; Van Dijk, 2009). Generally, elderly people do not always trust technology mainly due to their perceptions and attitudes (Chiridza et al., 2019; Nikou 2015). Data security becomes a concern when the user of the system has little knowledge regarding the technology they are using. When data confidentiality, integrity and availability are questioned, mistrust levels in the MMC systems

will rise. A fully functional MMC system is one that ensures that confidentiality, integrity and availability are maintained at all times.

Issues relating to accessing health information were also raised as points for concern (Paul & Irvine, 2014). Further engagement on the attitude, beliefs and perception indicated that elderly people had little or no training on the use of MMC systems. As a result, elderly people are more likely to divulge information to both known and unknown audiences (Vitak, et al., 2015). This was evident in the manner in which the elderly participants freely divulged their health information during the data collection process.

During the interview process, eleven participants indicated that they had disclosed personal information in online platforms. Four participants stated that they had medium media literacy skills and engaged in social network discussions, especially pertaining to health and social networking among peers.

"I do not entirely trust the information from the mobile watch, but I wear it to record my daily steps". (Participant 8)

As elderly people depend on fixed income, owning a mobile device may be an expense, especially given the socio-economic conditions applicable to most elderly communities (Kasiram and Holcher, 2015). The attitude of the elderly towards adoption of MMC systems necessitates a change in perception from society and government so that these elderly communities can receive a holistic plan to improve their lives (WHO, 2015).

"I cannot afford a smart device with my pension money so I rely on my grandson to translate the health information I need from the internet and I always reply honestly to all questions asked". (Participant 12)

Given the ease with which the elderly folk engage in the privacy paradox, they are at risk of a security breach that may pave the way to security vulnerabilities. Issues like identity theft may open the elderly to loss of control of their personal information. In terms of the POPI Act (2013), all individuals have the right to enjoy protection of their personal information (Whitman & Mattord, 2017). However, when the information is readily provided without any safeguards and controls in place, how is it protected? For future studies, it might prove useful to examine the possibility of adding the elderly's perspectives to the available National Cybersecurity Policy Framework (NCPF) or to increase the scope of the POPI in relation to the elderly.

6.6 Technology Construct

The technology construct falls under the technical subset of the STS theory. In this quadrant the discussion is about affordability, cost, ICT infrastructure and the value received from using MMC systems for the healthcare of the elderly.

6.6.1 Level of Affluence

The number of pensioners relying solely on age old grants is approximately 6%, while only 16% retire independent of family support. About 31% of the elderly are forced to return to the workforce to be able to provide for their families. Approximately 47% of the elderly retirees depend entirely on family and friends' support (McCallum, 2017). The South African government faces a huge challenge in fulfilling the needs of the elderly. It therefore formed partnerships with non-governmental organisations (NGOs) through the Department of Social Development (DSD) to assist the government to bridge the gap caused by an inadequate government funding model. The NGOs rely on donor-funding to carry out their partnership mandate (Western Cape Government, 2020). The primary areas supported by NGOs includes frail care, assisted living and social services.

Government only provides about 51,9% for frail care and the remaining 48,1% falls on NGOs to provide. The NGOs do not receive any form of subsidy for assisted living, thus putting strain on an already overstretched NGO funding to provide for the elderly who need assistance. In 2017, the shortfall was almost R2950 per elderly person (McCallum, 2017). Nikou (2015) states that elderly people need to feel socially included among peers. Participants 1, 2 and 3 echoed similar sentiments regarding affordability issues. Participant 1 reflected,

"My neighbour recently showed me how her cell phone reminds her to take medication, but unfortunately I cannot afford that kind of phone on my government pension". (Participant 1)

Participant two commented,

"Our government can assist pensioners by introducing coupons for the elderly like they do at the supermarket where we don't pay the same price for our groceries as other people and that helps stretch the pension". (Participant 2)

Participant 6 stated,

"I wish pensioners could get free internet so that we could get quick information about our health conditions". (Participant 14)

These statements echo the frustrations of most elderly people on government pension as they report that their pension money mostly covers board and lodging expenses. Some elderly people even displayed willingness to reside in old age homes, but even that is another challenge in South Africa (Kasiram & Holscher, 2015). The NGOs could aid the elderly living at home through their donor funding, but the South African funding model is also problematic and constrained. The NGOs are seriously constrained to fully offer social services to the elderly. The cost of subsidised social services by government was R16 per person in 2017, while the costs were at R64 per day in a lifestyle centre (Ferreira, 2017; Farrell, 2019).

In developing countries, most elderly communities rely on a fixed income and cannot afford health insurance (McCallum, 2017). In South Africa, the fixed income is in the form of a government old age grant, leaving the elderly to make use of state health resources for their healthcare needs. During the interview process, most participants confirmed that the grant is not enough to afford the elderly extra necessities like mobile devices and health care items. This viewpoint is corroborated in the study by Kasiram and Holscher (2015) where elderly communities in KwaZulu Natal stated that, despite being made aware of the benefits of mobile devices, their social circumstances prevent them from ownership. Hence the findings in this study allude to affordability being a determinant for adoption of MMC systems for elderly healthcare.

"Buying data is a luxury I cannot afford, my medication comes first, especially now that we are no longer supplied freely". (Participant 13)

Elderly people in South Africa are mostly dependant on old-age pensions and they argue that stretching that money to last a month is a struggle (Statistics South Africa, 2015; Kasiram & Holcher, 2015). The adverse effect of the affordability issue impacts on adoption levels of MMC systems, which are currently low. The decision to improve adoption levels by the elderly living in the home environment ultimately rests with government.

6.6.2 Cost of Technology

Data Cost

The issue of affordability is exacerbated by high internet costs. Reportedly, South Africa is one of the countries with the most expensive internet costs (McCarthy, 2019). South Africans are paying far more than their counterparts in developed countries. Italians pay about $0,49 for 1GB while South Africans pay approximately $7,60 for 1GB (Bottomley, 2020). As most elderly people depend on the state old-age pension, accessing health information is impeded

by the exorbitant internet costs in the country. In essence, this means that although elderly people may own mobile devices, access to healthcare information remains a challenge.

Available research on the high internet costs argues that there is a risk of lower morale if the elderly folk constantly face access barriers to healthcare (Zeissig et al., 2017). Participant 10 relies on the internet for health information, but is challenged by the expensiveness of data. The participant stated:

"It is so disheartening not being able to find information because my pension money does not stretch far into the month and data is too expensive". (Participant 12)

There is an ongoing debate about high internet costs in South Africa and during data collection, the participants shared their sentiments and they were similar to those shared by participant 10. Participant 15 stated,

"If I did not connect to free Wi-Fi at work, I would be unable to afford data for my smart watch and therefore unable to monitor my chronic illness". (Participant 15)

Participant 8 argued that he did not wholeheartedly believe in mobile devices for healthcare. However, despite the scepticism shown, he stated:

"I must say though the health app on my phone uses work Wi-Fi and assists me in monitoring my body activity without the inconvenience of visiting a healthcare facility and buying expensive data". (Participant 8)

It would be a great injustice to have impediments to the benefits associated with MMC systems because of affordability. With an ailing health system and multiple diversities in the country, adoption of MMC systems for the elderly's healthcare offers great potential to alleviate the burden and to improve the standard of living at home.

Cost of Information and Communication Technology infrastructure

Rural and remote areas in developing countries constantly face the reality of a lack of infrastructure from a combination of economic and social factors. As a developing country, there are huge inroads made by the South African government towards the provision of ICT infrastructure to the citizens. However, rural areas in the most populated, yet least resourced province in the country, still grapple with network challenges. Unfortunately, these areas accommodate the greatest number of elderly people in South Africa (Statistics South Africa, 2019).

Participant 6 has rural origins and visits the homestead on occasion. She lamented the obvious lack of connectivity and stated,

"My neighbours in the village are suffering because there is always no network at the clinic. The rural clinics could do with improvements, but government is taking its time and the elderly people continue to suffer because they cannot access quality healthcare". (Participant 6)

Participant 11 had this to say about ICT infrastructure or lack thereof,

"As a former nurse, the inability to access healthcare poses a danger to society as this may lead to despondency and result in non-adherence by elderly people". (Participant 11)

The adverse result of no ICT or marginal levels of ICT infrastructure could impact negatively on the morale of the elderly and healthcare workers. Elderly people may not realise the need to comply with adherence if emergency services are not available when needed. Unfortunately, the decision to improve access to ICT infrastructure rests with government. Decision-making in the health sector is compromised by the tunnel approach used which is process-based rather than people-centric (Chiridza et al., 2019; Rice & Estes, 1984). The response to these challenges maybe a concerted approach involving access to ICT infrastructure, reduced or sponsored data costs and the provision of a value-based healthcare system.

6.6.3 Value for Money

The value benefit associated with higher adoption levels of MMC systems for the elderly's healthcare cuts across the entire care spectrum from family to caregiver to physician. During the interview process, elderly people commended the functionalities of MMC systems for healthcare on how they made their lives better.

"I am no longer afraid of moving around my bed because I know help is readily available in cases of an emergency, thanks to my monitor". (Participant 4)

The following statement comes from participant 13 who has mobility issues and has a perimeter-monitoring device with fall detection capabilities. When a question was posed on why she is not at an institution for elderly people, the response was,

"I prefer living in my home because I get a sense of community from the neighbours. I have all the help I need from the technology surrounding me". (Participant 13)

Participant 11 uses her smartphone for social activities, which include health talks and getting health information from the internet. She responded:

"The information I receive from the web was worth every cent I spent on buying the gadgets I have". (Participant 11)

The only downside to this conversation were the impediments that prevent access to healthcare as a result of socio-economic conditions in under-resourced areas like KwaZulu Natal, Eastern Cape, Limpopo and Mpumalanga. The importance of community-based service cannot be over-emphasised in the dialogue regarding the elderly (Kelly et al., 2019).

6.7 Tasks construct

These include, but are not limited to, creating innovative methods to solve the elderly's plight, usability and user experience of MMC systems for healthcare. It would be advisable to rethink the design methods and user interfaces of mobile devices also (Charness et al., 2016). The following section briefly describes the themes applicable to the tasks' construct.

6.7.1 Insufficient Training and Lack of Skill

The lack of technical skills is noticeable in elderly people. According to Martin-Hammond, Vemireddy and Rao, (2019), elderly people would like to have MMC systems that can accommodate the less technically inclined users. Lack of education is a challenge facing most elderly people. This challenge is corroborated by the sentiments expressed by Participant 4,

"At my age, I cannot be bothered with learning how to use a mobile device. That is why I have a permanent caregiver who helps me with such things". (Participant 4)

The lack of technical skills can be attributed to the prevailing social circumstances at the time. The apartheid era is credited with the challenges facing the elderly due to inadequacies in the education system (Morris & Hyslop, 1991; Benatar, 2013; von Fintel & Richter, 2019). The ubiquity of mobile healthcare devices fails to deliver the benefit of convenience due to lower health literacy levels. These have resulted from the high levels of illiteracy among elderly people. It stands to reason then that Vandenberghe et al. (2018) echo the same sentiment as Participant 4 of putting the onus of training on the caregiver.

"In our time girls could only go to school up to Standard 6, if you were catholic and attended boarding school, then you became lucky and would go up to JC (currently Grade 10 or Standard 8 in those days).

The same argument is applicable to healthcare workers who do not have adequate technical skills. There seems to be a general consensus about removal of core functioning and technical

training by healthcare workers. Healthcare workers do not openly welcome the added skills set, although it carries a benefit of improved response time and quick decision-making. The other benefit of added technical skills is the reduction of procedures like blood tests. All of these endeavours offer improved medical care to the elderly and reduce anxieties associated with visiting healthcare centres (Vandenberghe et al., 2018).

Lack of technical skills within the healthcare sector need to be improved to reduce the digital divide currently in existence. The digital divide can be referred to as educational and socio-economic disparities that exist between digital natives and digital immigrants. Digital natives refer to individuals who are born in the era of digital technology or "native speakers" of technology using computers, games and the internet. Digital immigrants refer to those individuals that were born outside the digital era, but have adapted to digital technologies (Prensky, 2001).

The increased proliferation of MMC systems means healthcare workers need to be sufficiently skilled to achieve maximum benefit from available healthcare technology. Intensive technical skills training therefore becomes imperative to reduce the burden on healthcare resources (Malwade et al., 2018; Ovando et al., 2018; Quaglio et al., 2016; Sunyoung et al., 2016).

6.7.2 Reduced Burden on Healthcare Resources

The rapid growth of the elderly population is putting a huge strain on governments globally, especially in under-resourced and developing countries like South Africa. The South African government has made huge inroads in primary healthcare, but even that is not enough. For elderly people living at home, the use of MMC systems can relieve the pressure on government resources. The MMC systems can assist in monitoring, tracking, as well as fall detection of the elderly. If the elderly make use of MMC systems, there is less worrying among family members who have elderly people living on their own. According to (Lehohla, P, 2019), there are more females than males living on their own. Participant 11 echoed this sentiment as well and reflected,

"As an elderly woman living alone, it is important that I surround myself with all these gadgets even though they may sometimes be expensive. However, the cost is outweighed by the peace of mind in knowing I am taken care of even in my sleep". (Participant 11)

Monitoring systems provide constant monitoring around the home. Any incidents that occur are recorded, stored and accessed by people who are authorised to do so. This kind of monitoring is especially helpful to people with cognitive and mobility-impairment challenges

like Alzheimers' and Parkinson's diseases (Goldman, 2018). Participant 15, who is also a healthcare worker, stated:

"It is not easy to look after the patient when he or she is used to doing things her way. However, having the monitor around the house assists me to continue with other duties". (Participant 15)

The South African healthcare system is inadequately resourced to look after all the people suffering from such impairments and the availability of MMC systems in the home environment provides much needed relief to government health resources. However, most elderly people in South Africa do not have the means to obtain MMC systems for healthcare.

Literature indicates several factors preventing access to MMC systems for the elderly's healthcare. Legislation, design, privacy concerns, technical training and affordability are the major barriers identified in both literature and during data collection (Zeissig et al., 2017). Until the dialogue to improve adoption of MMC systems by the elderly living at home intensifies, the burden on healthcare resources will remain the same or increase.

6.7.3 User Interface Design of MMC Systems for the Elderly's Healthcare is not user friendly

Mobile devices have become smaller with more computational power in recent years, but these mobile device designs invoke a feeling of exclusion where elderly people are concerned. They would rather not use technology because of the complications associated with technical operations in MMCs and associated devices like mobile phones and tablets. Elderly people battle to understand instructions pertaining to assembly and the setup of mobile devices. A solution to this problem may be mobile devices that come pre-installed to enable the elderly to continue operating without worrying about the set-up which is the current situation facing them now. According to Malwade et al. (2018), operating smart phones, access to data and understanding the operational instructions of mobile devices have proven to be a challenge to both the healthcare workers and the elderly. One of the participants expressed the same sentiment and chose not to use the mobile device instead of learning how to navigate a complicated user interface.

"I depend on the care-givers to assist me with setting up the volume and language from my smart phone since I depend on it for normal hearing". (Participant 5)

"Going through the user manual is an inconvenience, I am unable to understand the instructions because I am not well-educated". (Participant 4)

The lack of technical skills in most elderly people plays a role in their dis-interest to learn any new methods, especially the ones deemed 'a nuisance', like going through a user manual. The mental skills access barrier comes into consideration as the elderly person would rather not use the mobile device than be subjected to what they may perceive to be complicated operations.

"All I know is to answer and make calls on the phone. If I want to look for information, I ask my grandson to help because I don't know how to do that". (Participant 12)

Another aspect that came out of data collection relates to the monitoring of the mobile devices, especially the wearables. The pacemaker needs constant monitoring that requires the owner to visit the healthcare centre on a monthly basis. Since the device does not transmit information in real-mode, the onus for monitoring and ensuring normalcy falls on the patient.

"Every month I have to visit the doctor so that he can check that the device is still working normally" (Participant 10)

Available literature, exploring why there is a lack of adoption towards MMC systems for the elderly's healthcare, alludes to gaps in the understanding of elderly people regarding user requirements and the health condition of the individual elderly person (Saare, Hussain, & Yue, 2019). One of the conditions afflicting the elderly is reduced mobility and diminishing cognitive functions. Cognitive function refers to the ability of the elderly to think and process information (National Institute on Aging, 2020). This therefore means that when the elderly persons are confronted with using complex user interfaces, it becomes difficult for them to grasp what is required, especially as they progress in age (Chen et al., 2018). There seems to be a paradigm shift among researchers on adoption of MMC systems about perceived design aspects and related mobile devices for the elderly's healthcare (Petrovcic, Taipale, Rogelj, & Dolnicar, 2018); (Anderson & Perrin, 2021); (Young, Koppel, & Charlton, 2016). This involves rethinking user interfaces of mobile devices and the inclusion of the elderly in the debate about their healthcare needs (Charness et al., 2016). The elderly people below 70 years of age made it clear during the interview process that the dialogue regarding them can never be complete when they are excluded from it.

Elderly people consider independence as a primary factor, but this becomes challenged when elderly people become afflicted with illnesses that affect their cognitive abilities, mobility and

dexterity. This is particularly so especially in the elderly living with cognitive-impairment and mobility-reducing diseases like Arthritis, Osteoporosis, Alzheimers' and Parkinsons (Goldman, 2018; Charness et al., 2016). When the user-interface design only caters for the elderly that have their full faculties and capabilities, the user requirements need rethinking to accommodate all the elderly, despite their limitations.

6.8 Critical Success Factors Identified to Optimise Adoption of Mobile Monitoring and Care Systems by the Elderly Living at Home

Several authors assert that the proliferation of mobile technology will not be fully beneficial if the adoption uptake is not increased (Chiridza, Wesson & Vogts, 2019; Chen, 2018; Almarashdeh et al., 2018; Aghanavesi et al., 2017). The following critical success factors (CSFs) were deemed to be the crucial factors that need to be seriously considered if the plight of the elderly is to be resolved.

6.8.1 Introducing Data Governance Framework for the Elderly's Healthcare

This critical success factor addresses the following themes:

- Procedures construct: Lack of Data Governance to Regulate Data Sharing between MMC Systems Leads to Privacy and Security Issues
- Procedures construct: Government Intervention is Pivotal to Standardisation of Mobile Monitoring and Care Systems for the Elderly's Healthcare
- Intrusive Nature of Mobile Devices Breach the Privacy of the Elderly

The current government legislation for the healthcare of the elderly is process-centric and therefore enjoys low trust margins by the elderly communities (Kelly, et al., 2019). Due to the diverse needs of the elderly, a multifaceted and consultative approach is better suited to improve adoption of MMC systems for their healthcare. During the data collection process, elderly people lamented the exclusion of themselves in dialogues concerning their needs. The gradual increase of the elderly population necessitates the inclusion of the elderly stakeholders and enhanced social facilitation measures as per recommendations of Agenda 2063 (AU, 2020).

The successful execution of CSF1 may lead to the formulation of policy and legislation regarding the elderly that will assist in addressing the elderly's healthcare issues as per the recommendations of NDP 2030 and Agenda 2063.

6.8.2 Improved Access to ICT infrastructure

- Technology construct: Cost of Technology
- People construct: Minimal Resistance towards Adoption of Mobile Monitoring and Care Systems
- Task construct: User Interface Design of MMC Systems for the Elderly's Healthcare is not user friendly

The ICT infrastructure plays a pivotal role in the elderly's healthcare. As an agent of change, ICT enables the provision of proactive, personalised healthcare to the elderly living at home. Such ICT therefore assists the healthcare sector in resource allocation. All the above need organisations to re-engineer and redesign normal business processes to maximise the potential benefits of ICT (Vimarlund & Olve, 2005).

Unfortunately, there is not enough evidence pointing towards a positive impact of ICT infrastructure for the elderly's healthcare. Available research into the impact of ICT infrastructure does not present enough evidence because it is process-driven and not needs-driven (Kelly et al., 2019; Borelli et al., 2019). The lack of evidence about the impact of ICT infrastructure on the elderly's healthcare needs to be researched in more detail.

The ubiquity of ICT infrastructure may improve decision-making during emergencies, especially in remote areas. A proliferated ICT infrastructure also carries the benefit of more open access channels to healthcare mobile devices at reasonable and affordable rates. The impact of open access channels could result in a reduced burden to healthcare resources which are currently under severe strain.

6.8.3 Integrated Health Information Systems

- Procedures construct: Government Intervention is Pivotal to Standardisation of Mobile Monitoring and Care Systems for the Elderly's Healthcare
- Tasks construct: Reduced burden on Healthcare Resources
- Technology construct: Value for Money
- People construct: Mobile Monitoring and Care Systems Promote Social Cohesion

Few elderly South Africans afford private healthcare since most of them are on state old age pensions and thus make use of the public healthcare system. South Africa has a fragmented HIS and thus elderly people are subjected to the same procedures when visiting healthcare facilities. This invokes anxieties in the elderly who at some stage admit to defaulting on health appointments to avoid repetitive procedures. In the era of big data, this should not be the case. However, the considerable lack of technical skills in healthcare employees results in process-

centric systems (Cassavia et al., 2016). A paradigm shift to patient-centred care is necessary to increase the likelihood of adoption of MMC systems by the elderly and healthcare workers (Wright, O'Mahony & Cilliers, 2017).

Integration of the disparate HIS could lead to less time spent at a healthcare centre, improved adherence levels and therefore a healthier elderly community that assumes a pro-active approach to their health. In the long-term, the South African healthcare sector may have a less burdened HIS.

6.8.4 Cheaper Internet Costs

- Technology construct: Level of Affluence
- Technology construct: Cost of Technology

The exorbitant costs of internet in South Africa are an impediment to the elderly's healthcare. Most elderly people depend on the state old age pension and the elderly cannot afford what they consider a luxury resulting from high internet costs. Cheaper internet allows for improved usability and interconnectedness as elderly people as well as healthcare workers would have better access to healthcare. One of the benefits of cheaper internet is associated with faster decision-making. Cheap internet also translates to enhanced deployment of tele-medicine especially in resource-constrained areas of South Africa (Stats SA, 2020). The implementation of cheaper internet costs could enable wide scale access to healthcare by the elderly.

6.8.5 Intensive Technical Training

- Task construct: Insufficient Training and Lack of Skill
- People construct: Technology Anxiety of the Elderly
- People construct: Attitude beliefs and perception of Mobile Monitoring and Care Systems
- Intrusive Nature of Mobile Devices Breach the Privacy of the Elderly

The ubiquitous nature of technology facilitates improved access to healthcare. Healthcare workers need technical training to improve productivity levels. A fully resourced health worker develops a positive attitude and thus increased productivity. The elderly community stands to benefit from a high morale associated with a conducive working environment for the healthcare workers (Almarashdeh et al., 2018; Botha, Botha & Herselman, 2015).

The use of big data in healthcare environments carries the potential benefit to improve adoption of MMC systems for the healthcare of the elderly. This may reduce the processing time spent

by healthcare workers to assist the elderly. Healthcare resources may also experience a reduction on the burden currently felt by healthcare systems as redundancies are removed by smart efficiencies (Abouelmehdi, Beni-Hissane, Khaloufi & Saadi, 2017).

The intensification of technical training would allow the elderly to be pro-active about their health. Adherence levels may increase thereby lessening the burden currently felt by healthcare resources. The technological anxiety encountered by the elderly may also be reduced as they realise the cost/benefit ration of the intrusive technology is worth the increase in their quality of health care.

6.8.6 Living Arrangements that Enhance Social Facilitation in the Elderly Communities

- People construct: Mobile Monitoring and Care Systems Promote Social Cohesion
- Technology construct: Level of Affluence
- Technology construct: Cost of Technology

Elderly people prefer to live independently to continue being part of their communities (Kelly et al., 2019). Research alludes to improved receptivity of technologies for the elderly's healthcare when the elderly people change their perceptions. Nikou (2015) refers to the psychology of inclusion and exclusion that speaks to enabling environments for elderly people. Enabling environments are created by access to healthcare, affordability of mobile devices and enablers of technology adoption like availability of mobile devices for healthcare (Borelli, et al., 2019).

Literature makes the assertion that living in communities is good practice for the elderly as it eliminates social exclusion. Improved living conditions in elderly communities enhance social cohesion whereby the elderly can develop a sense of togetherness. Community living may also enable an improvement in the security of the elderly.

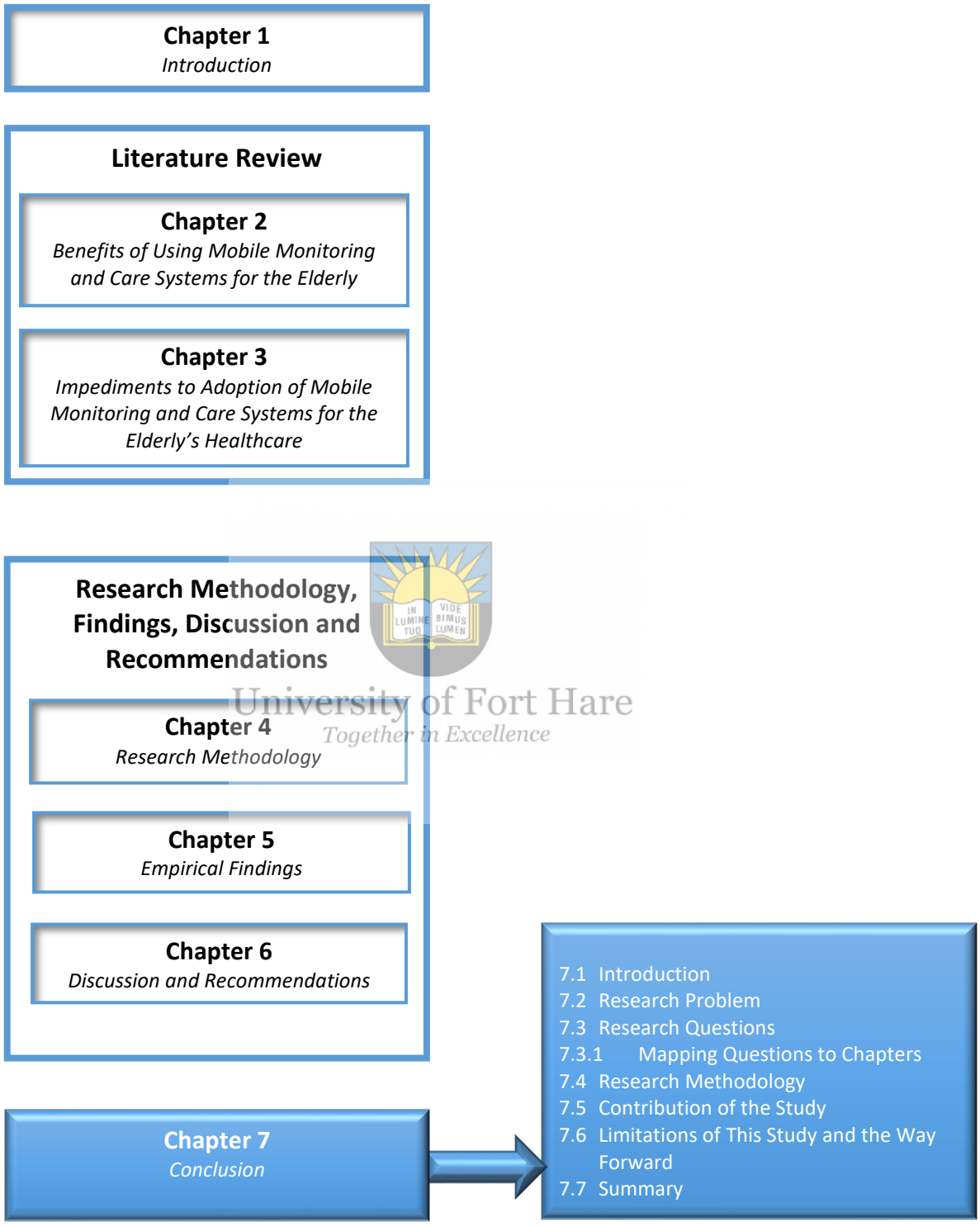
6.9 Conclusion

The discussion chapter addressed the research questions developed for the study and went into further detail about the data collection process. The study participants were mainly elderly females and one male who live in the home environment. As previously alluded to in the discussion chapter, most elderly males avoid participating in research studies. Literature attributes this behaviour to attitude and perception especially where health information is concerned.

The use of MMC systems for the elderly's healthcare carries potential benefits not only for the elderly communities but for government as well. The barriers identified by the study as discussed in the literature discussed in Chapter Two confirmed the findings found during the literature review. The major barriers to adoption of MMC systems for the elderly's healthcare relate to standardisation and lack thereof, access, the digital divide and cost. The stakeholders involved in improving adoption of MMC systems for the elderly's healthcare to reduce the burden on healthcare resources need to expedite the dialogue pertaining to the healthcare needs of the elderly.

The major impediments to adoption of MMC systems for the elderly's healthcare mostly relate to technology and costs. Critical Success Factors (CSFs) were developed as a contribution of this study to add to the existing body of knowledge about issues regarding the elderly. The six CSFs were developed according to the STS theory guidelines. As such, CSF1 and 6 address the procedures' construct, CSF 2 and 4 address the technology construct with CSF 3 addressing the people and CSF 5 aimed at the tasks' construct. The rationale behind the allocation emanates from the identified barriers from both literature and data collection. The continuing increase in numbers within elderly communities is worrisome to most countries because there are not enough interventions developed by countries, especially in resource-constrained regions. It is hoped that the issues will be addressed in future research studies.

CHAPTER 7: CONCLUSION



7.1 Introduction

The numbers of the elderly demographic are showing a continuous upward trend. Research attributes the upward trajectory to advances in healthcare and ubiquitous mobile monitoring technologies. However, adoption of MMC systems by the elderly living in the home environment remains low. The aim of this study was to explore why elderly people in the home environment do not adopt available MMC systems to alleviate the burden on healthcare resources.

The concluding chapter follows a retrospective approach by providing the reflections of the preceding chapters. The first part of the chapter communicates where the research questions were mapped to the study. The latter part of the chapter briefly alludes to the limitations and to recommendations for future research. The following section provides a brief overview of preceding chapters.

7.2 Research Problem

An extensive literature review revealed that access, affordability, the value and belief system and lack of standardisation regarding the use of MMC systems for elderly's healthcare were identified as major barriers to the adoption uptake of MMC systems for healthcare. The literature review however also identified benefits of using MMC systems for the healthcare of the elderly. The assertion is made that the benefits of using MMC systems for the elderly's healthcare carry benefits of enhanced accessibility, improved interoperability, improved lines of communication and decision-making plus the deployment of tele-medicine to bridge the digital divide.

The research participants revealed that they were not averse to adopting MMC systems for their healthcare. The MMC systems are considered useful tools in monitoring by the elderly living at home. It transpired that elderly people have a natural distrust of technology resulting in privacy, trust and security concerns among the elderly community. The lack of trust pointed to an attitude, behaviour and perception challenge that needed to be mitigated in order to improve adoption of MMC systems for the healthcare of the elderly. In addition to the above, issues pertaining to information sharing were raised as barriers to adoption. Invoking various legislation and standardisation protocols for data sharing in relation to information privacy and data governance was seen as a possible determinant. Further to these challenges were the

affordability concerns raised by the elderly. The conclusive thought leaned towards affordability playing a pivotal role in adoption of MMC systems for the healthcare of the elderly. Thus, even if the elderly folk are trained to use MMC technologies, adoption levels remain challenged by the cost of technology which is largely aligned to affluence levels, especially in developing countries.

The findings of the study indicated that there is congruency between literature and what was learnt from the participants. The tone of the participants alluded to access, affordability and lack of standardisation as major impediments to high adoption uptake of MMC systems for their healthcare.

7.3 Research Questions

The ubiquity of mobile devices and the upward trajectory of elderly communities necessitated an urgent dialogue pertaining to the issues of the elderly. Between 2006 and 2030, the number of older people in less developed countries is projected to increase by 140 percent as compared to an increase of 51 percent in more developed countries (Dobriansky, Suzman, & Hodes, 2021). This is attributed to the progressive ageing of the older population itself. Modern medicine and advanced skills have opened the life expectancy window even wider! As the oldest-old increase in number, so will four generation households become more common. As the elderly become more concerned with health issues due to aging, healthcare is at the forefront of considerations regarding the elderly. However, it is prudent to note that with the rise in the numbers of the elderly, so do healthcare costs. The high healthcare costs put the elderly in a precarious position, especially in resource-constrained areas. In South Africa, most elderly people do not afford private healthcare and depend on state-owned resources and family for support.

In addition to the above realisation, governments were not ready for the growing elderly population. According to WHO (2019), there are very few strategies to enhance the quality of life of the elderly. Research on the elderly's issues states that mobile technologies were identified as enablers to improved adoption of healthcare by the elderly. This study therefore sought to develop critical success factors to improve adoption of MMC systems for healthcare by the elderly in the home environment as this would alleviate the burden on healthcare resources. The following section provides a synopsis of the research questions and the sub-questions developed to answer the main research question.

7.3.1 Mapping Questions to Chapters

The study developed three sub-questions that sought to answer the main research question. In order to understand the reasoning behind the lack of adoption among the elderly requires understanding of the associated benefits, barriers to adoption as well as the contribution of the study in the form of critical success factors. The following section seeks to provide a map of where in the study the questions were addressed. The last paragraph is a brief summary of the study findings.

The primary objective of this study was to explore the reasons elderly people do not adopt MMC systems for healthcare. Research alludes to MMC systems as enablers to reducing the burden on healthcare resources. However, elderly people especially in resource-restricted communities, face challenges in adopting available healthcare technologies.

The main research question of this study posed this question, ***"How can the adoption of mobile monitoring and care systems for healthcare monitoring be improved among the elderly living at home in South Africa"?*** The study developed three sub-questions to seek answers to the main research question. Chapter 2 of the study addressed the first sub-question, ***"What are the healthcare benefits of using mobile monitoring and care systems for the elderly in the home environment?*** Chapter 6, the analysis component of the study found that both literature and data collection confirm the availability of associated benefits of adopting MMC systems for elderly healthcare.

The second sub-question of the research study was addressed in Chapter 3 and posed the following question, ***"What are the impediments to the adoption of mobile monitoring and care systems for healthcare amongst the elderly in the home environment"?*** The ensuing discussion for Chapter 3 started by exploring the socio-technical systems theory which is the premise upon which this study is based. The barriers identified to be impediments to the adoption of MMC systems for elderly healthcare were aligned to the different quadrants of the STS theory.

Since the study is explorative in nature, reasons for low adoption levels led to the contribution of this study to the existing body of knowledge. The third sub-question posed the question, ***"What are the critical success factors necessary to implement mobile monitoring and care systems for healthcare monitoring amongst the elderly in the home environment"?*** Based on the literature review, six critical success factors were developed to assist the elderly to increase

adoption levels of MMC systems for healthcare. Each CSF was assigned to the appropriate quadrant of STS theory.

The research findings pointed toward specific categories according to the four constructs of the STS theory framework. In the people construct, there is evidence from both literature and participant interviews that alluded to attitude, behaviour and perception. Secondary to these were the privacy, trust and security concerns raised by the elderly as barriers to adoption of MMC systems for their healthcare. From a procedural perspective, the lack of standardisation was also considered as an impediment to adoption of MMC systems. The participants lamented the lack of visible social reform plans for the elderly communities. Research participants strongly felt that government intervention was a priority, especially in light of a gradually increasing elderly demographic.

From a technological perspective the adoption of MMC systems for the elderly's healthcare reportedly has the potential to revolutionise the healthcare sector. However, it is mostly current affluent elderly citizens who enjoy these benefits as affordability was flagged as a major impediment to adoption of MMC systems for their healthcare. The considerable lack of technical skills in the healthcare sector impedes on adoption of MMC systems by the elderly as well as the workforce in the healthcare sector. In addition to the above, access barriers as identified in both literature and research findings, have a cascading effect as they prevent use of and access to MMC systems for the elderly's healthcare. If the identified barriers are not addressed, there may be increased levels of resistance from the elderly communities which may have a further adverse effect on the already resource-constrained healthcare system. The following section briefly discusses the methodological perspective adopted by the researcher for this study.

7.4 Research Methodology

The study is interpretivist in nature while following a qualitative inductive approach. Interviews were considered to be the best suited form of data collection in order to satisfy the interpretive and subjective nature of qualitative studies. Semi-structured interviews were conducted from a population sample of 15 elderly people in their living spaces. Purposive sampling was deliberately chosen to satisfy the subjectivity inherent in qualitative studies and also for the qualities that the elderly participants living at home possessed.

7.5 Contribution of the Study

Barriers identified to be impediments to the adoption of MMC systems for elderly healthcare led to the development of six critical success factors necessary for increased levels of adoption. According to the quadrants of STS theory upon which this study is based, a comprehensive plan of action regarding the elderly is required to facilitate better quality of life for the elderly communities. This means enhanced access to healthcare for the elderly becomes the key factor under consideration since the elderly are mostly worried about their healthcare needs as they progress with age. In addition, suitable living arrangements that enhance social facilitation in elderly communities carry the benefit of an improved quality of life designed to provide the elderly with a sense of belonging and improved social cohesion. The social inclusion created from being a part of elderly communities encourages the elderly to be more proactive towards their healthcare. Critical success factors 1 and 6 address the procedural aspects in relation to the needs of the elderly.

Technological barriers associated with affordability resulted in the development of critical success factors 2 and 4. The high cost of internet in South Africa prevents access to enhanced healthcare by the elderly. Lack of ICT infrastructure poses an added challenge due to the unique nature of the South African elderly's landscape. Research participants alluded to these barriers during data collection and literature corroborated these arguments.

The people quadrant exposed attitude and perception concerns relating to privacy, trust and security within elderly communities. Literature associated these privacy concerns to entrenched mistrust of technology by the elderly. This led to the realisation that intensive education and training campaigns were pivotal in the quest to provide enhanced healthcare as addressed by critical success factor 5.

Critical success factor 3 alluded to a fragmented HIS which adds an unnecessary burden to healthcare systems. The current state of fragmentation increases anxiety levels in the elderly as they become exposed to repetitive medical procedures on each visit to healthcare centres. The integration of HIS, therefore, is considered a key aspect of alleviating the burden on healthcare resources. All the above arguments therefore solidify the imperative issue of the formation of a data governance framework in relation to the elderly.

7.6 Limitations and the Way Forward

There are several factors that proved challenging to the completion of the entire study. These pertain to identification of research participants who needed to be chosen for the information they possessed in fulfilment of the purposive sampling guidelines. Purposive sampling seeks to choose participants to fulfil a particular purpose. The number of participants interviewed, the sector in which it is framed (elderly and mobile technologies) and the geographical component of the study were restricted to one area where adoption of mobile technology may not have been as problematic as others because the availability of MMC technology is not prevalent. Given the population of the research study, the sample size may not truly reflect the national perspective.

Since the study encountered the above limitations, it is recommended that for future studies a multi-case approach be adopted. The Eastern Cape is one of the poor provinces in South Africa with few elderly communities exposed to MMC systems for healthcare. Due to this constraint, the information received may be limited since many of the elderly people interviewed were not extensively exposed to MMC systems for healthcare. The inclusion of other areas may provide future studies with a more expanded perspective regarding adoption of MMC systems for the elderly's healthcare. This approach may provide an even better perspective on the true reflection pertaining to the status quo of the elderly and their healthcare concerns.

7.7 Summary

The study sought to explore the reasons for low mobile technology adoption levels among elderly people in South Africa. The findings of the research indicate that attempts to increase MMC systems adoption levels are hampered by legislative barriers. The South African government seems to be inundated with a state of unreadiness when it comes to elderly communities. There are no clear programmes in place especially in overly populated areas which coincidentally accommodate the majority of elderly communities. This necessitates government buy-in as a major stakeholder in the dialogue regarding the elderly to ensure maximum participation across the spectrum.

Socio-economic conditions of the elderly communities exacerbate the issue as affluency levels determine affordability in most resource-constricted areas. Although mobile technologies have been identified to have the potential to revolutionise healthcare, they are currently considered luxurious and thus the prevailing socio-economic conditions in the country add to the inhibitive factors towards increased adoption of MMC systems for the elderly's healthcare.

The lack of access to ICT infrastructure was also identified as a barrier to improved adoption levels among the elderly. High internet costs continue to hamper the efforts of the elderly who depend on state old-age grants and family support for their daily living. Even though the technology is available to enhance the elderly's healthcare, the battle for healthcare access continues until ICT infrastructure is rolled out into the remote and rural areas in the country.

The dialogue about ICT infrastructure cannot be complete if technical training is excluded. Healthcare workers and elderly communities confirmed the need for an intensive technical training drive in the healthcare sector. During data collection it transpired that healthcare workers and the elderly struggled with using mobile technologies. In certain instances, this has led to shifting responsibility of care to the healthcare workers. The MMC systems for the elderly's healthcare offer the potential to reduce the burden currently felt by the healthcare resources.

The current modus operandi of the South African health systems is fragmented with many HISs being spread across the nation. Technological anxieties among the elderly come to the fore under these circumstances as these patients experience the same medical procedures every time they visit healthcare facilities. The consequences of these actions result in increased non-adherence thus adding even more strain on healthcare resources than previously. Therefore, achieving seamless operability and time efficacy within the healthcare sector requires urgent intervention. Such measures would alleviate the burden on healthcare resources thus improving the quality of life of the elderly communities.

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Appendix 1 – Ethical Clearance Certificate

University of Fort Hare
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ETHICS CLEARANCE
REC-270710-028-RA Level 01

Project Number:	CIL011SFOT01
Project title:	**Factors influencing the adoption of mobile health monitoring and care systems by the elderly living at home in South Africa: A case of Buffalo City Municipality, Eastern Cape.**
Qualification:	Masters in Information Systems
Principal Researcher:	Yolande Fotoyi
Supervisor:	Prof L. Cilliers
Co-supervisor:	N/A

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby grant ethics approval for CIL011SFOT01. This approval is valid for 12 months from the date of approval. Renewal of approval must be applied for BEFORE termination of this approval period. Renewal is subject to receipt of a satisfactory progress report. The approval covers the undertakings contained in the above-mentioned project and research instrument(s). The research may commence as from the 22/08/19, using the reference number indicated above.

Note that should any other instruments be required or amendments become necessary, these require separate authorisation.
Please note that the UREC must be informed immediately of

- Any material changes in the conditions or undertakings mentioned in the document;
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research.

The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

The UREC retains the right to

- Withdraw or amend this approval if
  - Any unethical principal or practices are revealed or suspected;
  - Relevant information has been withheld or misrepresented;
  - Regulatory changes of whatsoever nature so require;
  - The conditions contained in the Certificate have not been adhered to.

- Request access to any information or data at any time during the course or after completion of the project.

Your compliance with DoH 2015 guidelines and other regulatory instruments and with UREC ethics requirements as contained in the UREC terms of reference and standard operating procedures, is implied.

The UREC wishes you well in your research.

Yours sincerely

22/08/2019

Professor Pumla Dineo Gqola
Acting UREC-Chairperson
22 August 2019

Appendix 2 – Turnitin Report

10%	8%	4%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	hdl.handle.net Internet Source	1%
2	Meda Kudzai, Liezel Cilliers. "Mitigating the elderly's privacy concerns when making use of Mobile Monitoring and Care systems", 2016 IST-Africa Week Conference, 2016 Publication	1%
3	uir.unisa.ac.za Internet Source	<1%
4	digitalcommons.unl.edu Internet Source	<1%
5	scholarworks.waldenu.edu Internet Source	<1%
6	repository.nwu.ac.za Internet Source	<1%
7	Submitted to University of Fort Hare Student Paper	<1%
8	"Posters", The Journal of Nutrition, Health and Aging, 2009	<1%

Appendix 3 – Consent form and Questionnaire

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Ethics Research Confidentiality and Informed Consent Form

I, Yolande Fotoyi, is asking 15 elderly people in Buffalo City Municipality, Eastern Cape, South Africa to answer some questions, which we hope will benefit the elderly people and possibly other communities in the future.

The University of Fort Hare's Information Systems Department is conducting research regarding the adoption of mobile health monitoring and care systems for the elderly living at home in South Africa. We are interested in identifying the reasons that the mobile health monitoring and care systems for the elderly are not used in South Africa, particularly in the Buffalo City area of the Eastern Cape region. We are carrying out this research to help improve the adoption of mobile health monitoring and care systems in Buffalo City, Eastern Cape, South Africa. We also encourage the use of mobile health monitoring and care systems by the elderly to alleviate the burden on health care resources in South Africa.

The study will be conducted according to the International Declaration of Helsinki for research on human subjects. The University Research Ethics Committee has approved this research project and the Ethical Clearance number is XXXXX. The Committee reserves the right to inspect the research records collected during this research project in order to ensure that the project is being conducted ethically.

Please understand that you are not forced to take part in this study and the choice whether to participate or not is yours alone. However, we would really appreciate it if you do share your thoughts with us. If you choose not to take part in answering these questions, you will not be affected in any way. If you agree to participate, you may leave the interview at any time you wish not to continue answering the interview questions. If you do this there will also be no penalties and you will NOT be prejudiced in ANY way. Confidentiality will be observed professionally.

I will not be recording your name anywhere on the interview and no one will be able to link you to the answers you give. Only the researchers will have access to the unlinked information. The information will remain confidential and there will be no "come-backs" from the answers you give.

The interview will continue until satisfactory answers that address the issue have been considered received, but not subjecting the participant to any uncomfortable measures *(this is to be tested through a pilot).* I plead that you be open and honest when answering these questions. Some questions may be of a personal and/or sensitive nature. Some questions may happen that you have not thought about before, and which also involve thinking about the past or the future. We know that you cannot be absolutely certain about the answers to these questions but we ask that you try to think about these questions. When it comes to answering questions there are no right and wrong answers.

You can contact me or my supervisor if you have any further questions:

Mrs Yolande Odwa Fotoyi

University of Fort Hare

Telephone number:

043 704 7146/0713785716

E-mail: yfotoyi@ufh.ac.za

Prof. Liezel Cilliers

Information Systems Department

University of Fort Hare

Telephone number: 0437047067

E-mail: lcilliers@ufh.ac.za

If you have any further queries regarding the ethical clearance process please contact the Dean of Research.

GMRDC

University of Fort Hare

Telephone number: 0437042319/7095

INFORMED CONSENT

I hereby agree to participate in research regarding an investigation on factors influencing the adoption of mobile health monitoring and care systems by the elderly living at home in South Africa: A case of Buffalo City Municipality, Eastern Cape. I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop and exit this interview at any point should I not want to continue and that this decision will not in any way affect me negatively.

I understand that this is a research project whose purpose is not necessarily to benefit me personally.

I have received the telephone number of a person to contact should I need to speak about any issues which may arise in this interview.

I understand that this consent form will not be linked to the questionnaire, and that my answers will remain confidential.

I understand that if at all possible, feedback will be given to my community on the results of the completed research.

……

Signature of participant **Date**:……..

I hereby agree to the tape recording of my participation in the study

……

Signature of participant **Date**:……..

Demographic Information					
1. Gender:	Male	Female	Neutral		
2. Age:	60 - 65	66 - 70	71 - 80	81+	
3. Marital status:	Single	Married	Separated	Divorced	Widowed
4.Racial or ethnicity:	African	Coloured	Indian	White	Other
5. Religion:	Christian	Muslim	Hinduism	Islam	Non-religious /Other
6. Area of residence:	Urban	Peri-Urban	Informal settlement	Rural	
3. Level of education:	Below Matric	Matric	Higher Certificate	Diploma/degree	Post Grad
4. Employment status:	Pensioner	Unemployed	Employed	Self-employed	

I would like to ask you for your opinion and about your experience with using mobile monitoring and care systems (MMCs) for healthcare. Examples of MMCs include but not limited to: bed movement sensors, vital sign monitors and mobility sensors.

GENERAL QUESTIONS

1.	**What is your opinion of using mobile monitoring and care systems for your healthcare?**
2.	**What benefit can be provided by the mobile monitoring and care system to the elderly?**
3.	**What kind of smart device do you use?**
4	**How often do you use it?**
	PEOPLE
1.	**What are the challenges experienced by elderly people when using mobile monitoring and care systems for healthcare?**
2.	**Do you believe that mobile monitoring and care systems for healthcare can provide continuity of care for the elderly?**
	TECHNOLOGY
1.	**Are the mobile monitoring and care systems for healthcare properly designed for elderly use?**
2.	**Are the elderly people sufficiently skilled in using mobile monitoring and care systems for healthcare?**
3.	**Do elderly people receive adequate training on how to use mobile monitoring and care systems for healthcare?**
	TASKS
1.	**What tasks can the mobile monitoring and care systems for healthcare help the elderly to achieve?**
2.	**Are there any other healthcare tasks that mobile monitoring and care systems can assist the elderly to perform?**
	PROCESS

1.	What barriers from the environment inside the home influence the elderly not to use the mobile monitoring and care systems for healthcare?
2.	What barriers from the environment inside the home influence the elderly to use the mobile monitoring and care systems for healthcare?
3.	What barriers from the environment outside the home influence the elderly not to use the mobile monitoring and care systems for healthcare?
4.	What barriers from the environment outside the home influence the elderly to use the mobile monitoring and care systems for healthcare?
5.	Are there any factors that would promote the use of mobile monitoring and care systems amongst the elderly for their healthcare?

Appendix 4 – Proof reading certificate

TO WHOM IT MAY CONCERN

I have 42 years' experience in the teaching profession, both at high school and tertiary level. In my last position before retiring in December 2016, I was a Teaching and Learning Consultant and had acted as Manager of the Teaching and Learning Centre (TLC) of the University of Fort Hare on three different occasions. As a consultant, I facilitated modules on the Post Graduate Diploma in Higher Education and Training (PGDHET) and also evaluated lecturers' teaching and their courses. My skills set allowed me to focus on management, language, research and student development. Activities which speak to this include being the Co-ordinator of the Language and Writing Advancement Programme (LWAP) and the Supplemental Instruction Programme (SI) for two years plus being the Editor of the TLC's bi-annual newsletter for approximately eight years.

For the past three years I have been proofreading and editing for academics on a time-on-task basis. I hereby certify that I have proofread a Master's thesis submitted to me by the corresponding author, Yolande Odwa Fotoyi, Student Number201414065**,** whose study's research topic is:

` Factors Influencing the Adoption of Mobile Health Monitoring and Care Systems by the Elderly Living at Home in South Africa: A Case of Buffalo City Metropolitan Municipality'.

I have corrected superficial errors in spelling, grammar, syntax and punctuation in the abstract and the body of the manuscript. I have checked the balance required between in-text referencing and end- referencing, where the one needs to be a mirror image of the other, according to APA referencing guidelines. I trust that the aforementioned will meet with the examiners' approval and that the language used accurately reflects the author's intended meaning. Furthermore, I have made every effort to ensure that the manuscript is clear, reads smoothly and avoids confusion or misunderstanding. The principles of anonymity, confidentiality, accountability and reliability have been respected by all researching parties.

DISCLAIMER: The proofreader cannot be held responsible for any errors introduced after the proofreading has been completed, due to changes being made during the corrections' process.

Should there be any questions that arise from this exercise, kindly contact me on lscheckle@gmail.com.

Linda Scheckle (Private Editing Service) 22 January 2021