FACTORS AFFECTING THE USE OF MOBILE DEVICES FOR REMOTE DATA COLLECTION IN HOME COMMUNITY BASED CARE

Nobubele Angel Shozi

FACTORS AFFECTING THE USE OF MOBILE DEVICES FOR REMOTE DATA COLLECTION IN HOME COMMUNITY BASED CARE

By

Nobubele Angel Shozi

Submitted in fulfillment of the requirements for the degree

Magister Technologiae

in

Information Technology

in the

Faculty of Engineering, the Built Environment and Information Technology

of the

Nelson Mandela Metropolitan University

Supervisor: Prof. Dalenca Pottas

Co-Supervisor: Mrs Nicky Mostert-Phipps

January 2012

DECLARATION

I, **Nobubele Angel Shozi (20508671)**, hereby declare that this dissertation submitted for the degree to be awarded is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification.

NOBUBELE ANGEL SHOZI

LIST OF ACRONYMS

CBO	Community Based Organizations
CHCW	Community Health Care Worker
DOH	Department of Health
FBO	Faith Based Organizations
HCBC	Home Community Based Care
HIV / AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
ICT	Information and Communication Technology
NGO	Non-Governmental Organizations
PDA	Personal Digital Assistant
PLWHA	People Living With HIV and AIDS
WHO	World Health Organization

ABSTRACT

The health care systems of developing countries, which are already weak, have to carry an additional strain brought on by the burden of infectious diseases. This added strain means that the health care provided is not of the highest quality. The use of home community based care (HCBC) was introduced as an attempt to provide basic health care services to people through the services of community health care workers (CHCW). With the development of HCBC in developing countries and the CHCW playing a vital role in ensuring that the lives of people living with diseases are improved, the need for information and communication technology (ICT) solutions is increased. The information that is collected by the CHCW is paper-based and it cannot be analysed and used efficiently and effectively.

This study embraces the adoption of a socio-technical perspective when an ICT solution is introduced in an environment. A socio-technical perspective focuses on three dimensions: the user, the environment and the technology used. These three need to be in coherence to ensure that the technology is used effectively by the user within the environment. Therefore the objective of this study is to identify a list of socio-technical factors that affect CHCWs when they are using mobile phones for data collection purposes in home community based care. In order to achieve this it was necessary to understand how the socio-technical subsystems of the HCBC environment are constituted. The study followed a qualitative approach, including interviews and observations, to collect the data which will best enable the researcher to understand the home community based care environment, its people and the use of the technology to collect data in this environment, in particular mobile phones. A qualitative content analysis approach was followed to analyse the data and constitute a list of factors affecting the use of mobile devices for remote data collection in home community based care. It is hoped that this research will assist to inform the design of appropriate mobile health applications to both ease the burden of CHCWs (i.e. it should be faster and easier to use than paper) and improve the healthcare service provided through enabling access to patient records to all partners in the care continuum.

ACKNOWLEDGEMENTS

- I would firstly like to give thanks to the ***Lord Almighty*** for giving me the strength to persevere even at the darkest of times.

To my supervisor ***Prof. Dalenca Pottas*** - Thank you for always being the hand that pushed me to work beyond my limits. Your guidance and support throughout this research was invaluable.

- To my co-supervisor ***Mrs Nicky Mostert-Phipps*** – Your input in this research was greatly appreciated. Thank you for giving your time and sharing your knowledge.

- To my mother, ***Patricia***, my father, ***Eric*** and my sister ***Noxolo*** **–** Thank you for giving me the support that I needed all day and night. You saw my struggles and were always there with encouraging words of wisdom that gave me the strength to carry on.

- This research would not have been possible without the financial support from Telkom, South African Government (Department of Science and Technology) and the Government of Finland (Ministry for Foreign Affairs) through SAFIPA (the South Africa - Finland Knowledge Partnership on ICT) and the Nelson Mandela Metropolitan University Postgraduate Scholarship.

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PUBLICATIONS AND PRESENTATIONS STEMMING FROM THIS RESEARCH

Shozi, N., Pottas, D. & Mostert-Phipps, N. (2011). Data collection in the Home Community Based Care environment. Presentation at the HISA 2011 Conference, 29-30 August 2011, Johannesburg.

Shozi, N., Pottas, D. & Mostert-Phipps, N. (2011). A socio-technical perspective on the use of mobile phones for remote data collection in home community based care in developing countries. *Proceedings of the AFRICOMM 2011 Conference* (CD), 23 - 24 November 2011.

Shozi, N., Pottas, D. & Mostert-Phipps, N. (forthcoming). Perceived benefits of remote data capturing in community home-based care: The caregivers' perspective. *Journal of Community Informatics*. [Paper accepted for publication and pending final changes recommended by the reviewers].

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

There is an existing inequality between the health care of people living in developing countries and of those living in developed countries. This, according to the Declaration of Alma-Ata, is politically, socially and economically unacceptable (WHO, 1978). Due to the demand for more health care services in response to the growing epidemic of HIV/AIDS and other chronic diseases, alternative health care means are required in developing countries.

In this chapter in section 1.2, the background of the research study is discussed. The background lays the foundation for understanding why the research study is necessary. With the knowledge of the importance of the study, the problem statement, research questions and objectives are discussed in sections 1.3, 1.4 and 1.5 respectively. The research methodology that will be followed in the study is discussed in section 1.6 in relation to how the research questions will be answered and how the objectives will be met.

1.2 BACKGROUND TO THE STUDY

1.2.1 Health care in developing countries

The Declaration of Alma-Ata declares that health, which is a state of complete physical, mental and social being, is a fundamental human right (WHO, 1978). However, more than 30 years later this statement does not hold true in developing countries (Hall & Taylor, 2003). In Africa, the health care systems differ depending on the political-economic systems of each country and this influences the effectiveness of the health care system and how it works for the people (Van Rensburg, 2004). A weak health care system is a reflection of the poor economic state of a country.

Hill and Powell (2009) identify three major problems with the health care environment in the United States: accessibility, quality and cost. Similarly, health care in developing countries suffers from a lack of quality health resources (quality), a lack of medical expertise to aid the development of health care which results in the importation of medical expertise from other countries (cost) and limited access to health care by patients (accessibility) (Chan & Kaufman, 2010). These factors result in poor health services being provided to the citizens of these countries. People in developing countries have to face the burden of living in countries that are plagued with diseases. With a reported 33 million people living with HIV and AIDS (PLWHA) globally in 2007 and 22 million being from Sub-Saharan Africa (UNAIDS/WHO, 2008), it becomes clear that the health care systems in Sub-Saharan Africa will be challenged to the fullest extent, to provide adequate health care services to its people.

1.2.2 Role of Home Community Based Care in Health Care

The reality of a lack of health facilities and people without access to health services has resulted in the emergence of other alternatives. Non-Governmental Organisations (NGO's), Faith Based Organisations (FBO's) and Community Based Organisations (CBO's) offer Home Community Based Care (HCBC) services to try and eliminate the stress that is experienced by health facilities in developing countries. This alternative has become a necessity in the continuum of care in developing countries. The aim is to transfer some of the care responsibilities to family members and the communities in which the patients actually live. Home Care and Community Care are defined as follows according to the South African Department of Health (2001):

- Home Care is defined as the health services that are given to a patient in the home;
- Community Care is defined as the care that a patient can access nearest to their home and it encourages interaction with people and promotes community living.

These two definitions clearly define HCBC as the care that is given to patients in their homes by family and is supported by health care workers and the community which promotes interaction with different people. The 'Care Continuum' model developed in the mid 1990's by the World Health Organization (WHO) to provide a holistic approach to the care of PLWHA and other long-term diseases, defined HCBC as an important element in this model and its use has spread to developing countries (Browning, 2009).

The use of HCBC in the health care systems of developing countries has been beneficial to patients, their families and the government. Families do not have to spend money on transport costs to clinics and hospitals, and the government benefits because the number of patients in hospitals is reduced which results in care being less expensive (Uys & Cameroon, 2003). Consequently the patients have more personalized care because they are being taken care of by their family and the community (Uys & Cameroon, 2003). WHO (2002) stresses the importance of using a team approach to providing care in HCBC because this ensures that all the elements of care are included. The team is comprised of the patient, his or her family and the community health care worker (CHCW) who is the prominent role player.

1.2.3 Problems experienced by the Community Health Care Worker in the Home Community Based Care environment through use of paper-based records

With the development of HCBC in developing countries and the CHCW playing a vital role in ensuring that the lives of people living with diseases are improved, the need for ICT solutions is increased. The information that is collected by the CHCW is paper-based and it cannot be analysed and used efficiently and effectively. Estimations and projections are used because of the lack of reliable statistics on the diseases due to the use of paper-based systems (Busgeeth & Rivett, 2004). When a CHCW visits a patient at his/her home, they have to use various paper-based records which are discussed in more detail in Chapter 5. This process is prone to errors, such as files being lost or misplaced and illegible handwriting. The biggest problem with the use of paper-based records in the HCBC environment is that the

CHCW has to travel with these paper-based records from one patient's home to another and this is unsafe. These records contain confidential information such as patients' HIV statuses and if lost, could have negative effects on the patient.

1.2.4 How can ICTs help address the problems experienced by Community Health Care Workers in the Home Community Based Care environment with regards to the use of paper-based records

Paper-based records may be replaced with computerized records by using ICTs in the HCBC setting. Since patients living with diseases like HIV/AIDS depend on taking drugs their entire life, programmes like the DREAM programme realised the need to create computerized records that would manage the electronic health record of the patients from the beginning of their treatment (Nucita et al., 2009). Nucita et al. (2009) highlight a number of benefits from using computerized records in the HCBC context:

- It allows for the easy relocation of the information of a patient if he/she had to move from the HCBC setting to a clinic or hospital;
- The records of the patient are stored electronically which prevents them from being misplaced;
- They are backed up in case of unfortunate events like fire or flooding;
- Their access is only granted to authorized personnel.

The use of computerized records can have a positive impact in HCBC; however, there are some problems that could hamper their use. Cooper and Urquhart (2008) indicate that some CHCWs do not trust electronic information because they feel these systems are 'down' often and have limited capability. The CHCWs are intimidated by the sudden change from paper-based systems to computerized systems and they lack formal training in the use of these computerized systems. Before seeing the benefits of using ICTs in the HCBC environment in developing countries, there are various constraints which first need to be overcome and these are discussed in the next section.

1.2.5 Challenges and Constraints of using ICT in HCBC

The increasing need for ICT solutions can be shadowed by challenges preventing their adoption in the health sector. There are four constraints that can restrict the use of ICTs in developing countries, which include (Chetley, 2006, Satellife, 2005, Rao, 2005):

- Connectivity. These are issues such as the lack of access to electricity and insufficient telecommunications infrastructure;
- Capacity. ICT solutions do not seem to be well incorporated in developing countries. This is due to weak presiding governments and academic institutions that cannot afford to invest in educating the public. This leads to an inability to use and maintain ICT solutions;
- Culture. The cultural inhibitions of a community need to be identified because these can prevent the effective use of ICT;
- Capital. Investment in a project is the most important factor. A project can fail without adequate capital.

One ICT development that seems to be effective in the HCBC context and has the ability to overcome the constraints listed above is mobile devices (Chetley, 2006). This ICT development has the potential to be a solution to the constraints listed.

1.2.6 Potential Use of Mobile Devices in HCBC

Mobile health (m-Health) is the use of mobile phones and other mobile communication technologies within the health sector (Mechael & Sloninsky, 2008). It can be the channel that is used to support health workers to provide health services to communities as it has the ability to overcome the constraints listed. The potential use of m-Health is subdivided into six categories (Vital Wave Consulting, 2009):

- Education awareness. This area is focused on the use of Short Message Service (SMS) to educate and make people aware of disease;

- Remote data collection. Health workers use mobile devices as data collection tools to collect information about patients who are in remote locations;
- Remote monitoring. Patients can use the mobile devices to monitor their health in the comfort of their own homes;
- Communication and training for healthcare workers. The use of mobile devices can aid in the training of health care workers to do their jobs efficiently;
- Disease and epidemic outbreak tracking. Mobile devices can be used to rapidly transmit information about a disease outbreak;
- Diagnostic and treatment support. Mobile devices can be used to provide diagnosis and treatment advice to remote health care workers through wireless access to medical information databases.

Mobile users constitute 83% of telephone subscribers in Africa (Tomlinson et al. 2009); therefore, there is an opportunity to support health care provision through the use of mobile phones in the afore-mentioned categories. The use of paper-based systems will decrease with the use of mobile devices, which should eliminate the problems of lost files and illegible handwriting. The following are examples of the use of mobile devices in developing countries:

- Mobile Researcher is a mobile phone data collection system that has been used in Durban, South Africa to collect survey data about households in South Africa (Tomlinson et al., 2009). The surveys are carried out by CHCWs in the specific environments they work in. This application is useful because some areas in rural Kwazulu-Natal do not have fixed line Internet access but with the use of mobile devices, wireless networks can be used. The only requirement is for the mobile device to have the Java programming language enabled. Once a survey has been completed on the mobile device, it is automatically uploaded to the host computer. If there is no network coverage, the survey is stored until coverage is available. The uploaded surveys can later be analysed via a web-based platform.

- Vital Wave Consulting (2009) discusses 'The Cell-life Project' which is based in South Africa. This project is primarily for home-based care for patients living with HIV/AIDS. In this project, health care workers monitor patients using mobile

phones to record information about their medical status, medication adherence, etc. This information is transmitted via SMS to the central database where managers can access and monitor it.

Both these projects fall into the remote data collection category of m-Health applications. Although both projects have been successful for the purpose they were developed for, the adoption of technology is cited in both as a challenge during the implementation stages. The health care workers in these projects have to face difficulties both from the patients they aid due to lack of information, and from the technology they use to aid the patients because there is a sharp learning curve in the process of switching from paper-based systems.

How a user interacts with a mobile device-based application is different from a desktop-based application. Typical use of a desktop-based application constitutes a user sitting on a chair with his\her hands on a keyboard or mouse and looking at a screen. For a mobile device, it depends on the kind of device used, the environment it is used in and the social implications its use has on the user. The factors that could hamper the effective use of mobile devices in the HCBC environment can be linked to the three sub-systems of Socio-Technical Theory as defined by Baxter and Sommerville (2008).

1.2.7 Definition of Socio-Technical Theory

Socio-technical theory was first envisioned by the Tavistock Institute for Human Relations in London in the 1940's (Scacchi, 2003). Baxter and Sommerville (2008) define socio-technical theory as:

> "Systems that involve a complex interaction between humans, machines and the environmental aspects of the work system".

It is clear, through the above mentioned definition, that socio-technical theory has three interdependent sub-systems:

- Social sub-system. This sub-system represents the people that are internal to the organization. In the context of HCBC, the people involved are the CHCWs and other internal people like their supervisor or managers.
- Environmental sub-system. This is the environment that the caregivers and patients interact in. In the context of HCBC, this is the environment in which the caregivers work and where the patients reside. It is the environment in which the mobile devices will be used. The patients, their families and the community resort in this subsystem.
- Technical sub-system. This is the technology that is used by the people. In this research in HCBC, this is represented by the mobile devices that will be used by the health care workers.

Socio-technical theory implies that an organization is made up of both social and technical sub-systems and these can be manipulated by the environment.

1.2.8 The Socio-Technical Subsystems of m-Health in HCBC

It is necessary to understand how the socio-technical subsystems of the HCBC environment are constituted to ensure that mobile devices can be used effectively.

- Social subsystem. In a study conducted by Simpson (n.d) in South Africa, 36 of 42 CHCWs were female. This illustrates that in developing countries like South Africa, women are the ones carrying the burden of dealing with ill patients. Of these 42 CHCWs, the majority were between the ages of 31 and 50. These statistics show that in a country like South Africa, CHCWs are middle aged. CHCWs in developing countries have a low level of education (WHO, 2002). This impacts negatively when they have to record information on paper because literacy is an issue. The term ‘CHCWs encompasses a wide variety of health care workers who are chosen and trained to aid the community. WHO (2007) defines the term as:

  > “CHCWs should be members of the communities where they work, should be selected by the communities, should be answerable to the communities for

their activities, should be supported by the health system but not necessarily a part of its organization, and have shorter training than professional workers."

- Environmental subsystem. The environment that the care giver has to work in can be discouraging because there are a number of factors that impede them from carrying out their daily duties. Browning (2009) lists some challenges that HCBC programs have to face in Botswana which is seen as a typical developing country with respect to poverty, financial constraints, lack of transportation, water supply, basic facilities and lack of electricity.

  In developing countries like Botswana, at least 47% of the population lives below the poverty line (Browning, 2009). The CHCWs find themselves struggling to aid the patients because there is no food, water, clothing or proper sanitation in many households. Some patients are in remote locations and due to the lack of transportation in developing countries; it is difficult to travel to these remote areas. This travelling exposes the CHCW to the possibility of being the target of criminals. In South Africa, during 2008/2009, 2.1 million serious crimes were reported of which approximately 32.7% were contact crimes which include robbery (SAPS, 2009). CHCWs cannot work night shifts because, due to the transportation and crime problems highlighted, it would be unsafe for them to travel at night.

- Technical subsystem. South Africa had a population of approximately 49 million in 2009 (Statistics South Africa, 2009), at least 5 million of whom own a computer. This is a relatively small number compared to the 42 million mobile phone subscribers (Wikipedia, 2010). These statistics illustrate that mobile devices are increasingly used as communication tools by people in developing countries because they are cheaper and easier to use. This increases the chances of mobile devices being used in HCBC because they are already within the reach of the CHCW.

The adoption of health informatics into the health care environment has resembled that of businesses and commerce by using a techno-centric approach mainly

concentrating on the use of technology, software design and system development. Whetton (2005) describes techno-centric as the tendency to focus on technology and technological issues instead of viewing the technology as an extension or part of the wider system. It is just assumed that the technology will fit into the environment and it will be adopted by the user easily. This has proven to be a restricting factor in the health care environment.

It is being realised that technology is an influencing factor in the health care environment but it cannot stand alone. A techno-centric approach impacts negatively on the usability of technological solutions. The issues that the CHCW has to face highlight the need for a socio-technical approach when considering m-Health for use in the HCBC environment. The espousal of a socio-technical perspective is more appealing because it encompasses both the technology and the social and environmental factors.

1.3 PROBLEM STATEMENT

The problem that this research addresses is that socio-technical factors prevent the use of m-Health in the HCBC context. In particular, the remote data collection facet of m-Health in HCBC will be the focus of this research.

1.4 RESEARCH QUESTIONS

The primary research question is: Which socio-technical factors impact the use of m-Health in the HCBC context?

The following sub-questions must be answered in order to address this question:

- What is the role of HCBC in healthcare provision in developing countries?
- What are the current and potential uses of ICTs, specifically mobile devices, in the broader health care and HCBC contexts?
- Which factors can be identified that impact the use of mobile device for remote data collection in the HCBC context?

1.5 RESEARCH OBJECTIVES

The primary objective of this research is to compile a set of socio-technical factors that impact the use of m-Health in home community based care. These factors aim to promote the use of m-Health through gaining a better understanding of its impact in this environment.

The following sub-objectives have to be fulfilled in order to achieve the primary objective:

- Ascertain the role of HCBC in healthcare provision in developing countries;
- Establish how ICTs and specifically mobile devices are used in health care, including the HCBC context; and
- Determine the factors that influence the use of mobile devices for remote data collection in the HCBC context.

1.6 RESEARCH METHODOLOGY

Research is defined as ‘an investigation to discover facts’ (Olivier, 2004). These facts do not necessarily have to be new knowledge; it could merely be an addition to existing knowledge. According to Saunders, Lewis and Thornhill (2003), research has a number of characteristics: data is collected systematically, data is interpreted systematically and there is a clear purpose, which is to discover things. It is necessary to work within the boundaries of a research design in order to conduct research. This is comprised of choosing a research philosophy, research approach, research strategies and data collection methods.

The research ‘onion’ proposed by Saunders et al. (2003) is one design blueprint which can help a researcher to decide on a suitable combination within the layers of the onion. The research onion argues that before getting to the central point of collecting the data through, for example, administrating questionnaires or conducting interviews, it is necessary to start by peeling away the important outer layers. These are subsequently discussed.

1.6.1 Research Philosophy

For this research the research philosophy is interpretivism. Interpretivism allows for the researcher to interpret the data according to his/her own views. This is an ideal fit because the researcher is investigating the health care worker, the technology being used and the environment in which it is used. Saunders et al. (2003) points out that in interpretivism:

> "It is the researcher's role to seek to understand the subjective reality of those that they study in order to be able to make sense of and understand their motives, actions and intentions in a way that is meaningful for these research participants".

1.6.2 Research Approach

In this research study, the inductive research approach was used. The inductive research approach requires the researcher to collect the data and develop a theory based on the analysis of the data (Saunders et al. 2003). Neuman (2006) describes that inductive research requires the researcher to first carry out observation or interviews and based on these create a theory. This is the opposite of deductive research, which requires the researcher to first have a theory and then move towards providing evidence of it (Neuman, 2006). Inductive research is more open-ended because it begins with vague ideas and explores theories (Trochim, 2006).

1.6.3 Research Strategies

The following research strategy was followed, in order to fulfil the objectives of this research:

Case study. In a case study the researcher explores in depth one or more individuals, collecting information using a variety of data collection procedures over a period of time (Stake, 1995). In this research it allowed the researcher to explore in

depth and understand the social, environmental and technical factors that affect the way that health care workers would interact with mobile devices.

1.6.4 Time Horizons

The time horizon for this research study is cross-sectional as data was collected from a case study at a single point in time and the data examined to identify patterns and similarities.

1.6.5 Research Data Collection Methods

Three data collection methods were utilised to collect the data for the study:

- **Literature review**. A literature review shares with the reader the results of other studies that have been conducted that are related to the current study (Creswell, 2003). It highlights the importance of and need for the current study. In this study, a literature review was conducted through the reading of books, journals, other theses and articles so that knowledge could be gained in the fields of the health care industry, HCBC, mobile health, socio-technical theory and its application in HCBC and other contexts.

- **Semi-structured interviews**. Semi-structured interviews are less rigid than structured interviews because they allow the participants to add more questions and have more answers if there is a need to expand the information gained from the interview. These semi-structured interviews were conducted with CHCWs who perform data collection duties in a patient's home.

- **Observations**. Observations allow the researcher to take notes on the behaviour and activities of individuals at the research site (Creswell, 2003). Through observation, the researcher will better understand the participants' interaction with the environment and the technology used. Observations require that the researcher be in the same environment as the participant. In this research, it enabled the researcher to better understand the environment that the health care

worker works in and to identify the socio-technical issues affecting the health care worker. Observations were carried out of CHCWs while they used paper-based methods and a mobile device to collect patient data.

1.6.6 Data reliability and validity

Data was analysed following the qualitative content analysis process. To ensure that the data is reliable and valid the four criteria of assessing the validity of qualitative research – credibility, transferability, dependability and confirmability – are investigated in Chapter 2, section 2.6.2. The hermeneutics cycle was used in order to interpret the data and ensure that the researcher understands its meaning. This is discussed in Chapter 6 section 6.4.

1.7 DELINEATION OF THE RESEARCH

This research considers home community based care in resource poor settings. For this purpose, the literature review is limited to related literature in the developing country context. The definition of the developing country context adopted in this research is provided in Chapter 3 section 3.3. However, this does not mean that the outcome of the research can be generalized for developing countries, as only one case study was conducted in a resource poor setting in South Africa. In terms of achieving the objectives of the research, this is sufficient though to gain an understanding of factors affecting m-Health in home community based care.

1.8 ETHICAL AND LEGAL CONSIDERATIONS

This research requires interaction between the researcher and CHCWs. Information disclosed by CHCWs needs to be protected and used accordingly. In this regard, ethical approval was received from Nelson Mandela Metropolitan University.

1.9 OUTLINE OF CHAPTERS

Chapter 1: Introduction

This chapter introduces the research, highlighting the problem area, research questions, objectives and the research methodology.

Chapter 2: Research Methodology

This chapter examines research philosophies, approaches, strategies and data collection techniques that can be used. The research design that will be followed to answer the questions that were posed in Chapter 1 is provided.

Chapter 3: Health Care and HCBC in Developing Countries

This chapter discusses HCBC in its role of supplementing inadequate healthcare infrastructures and systems in developing countries. The focus is on explaining the role and impact of HCBC and the role of caregivers as prominent figures in HCBC. The current use of ICTs in the healthcare industry, including the HCBC context, and its challenges are investigated.

Chapter 4: Mobile Devices in Health Care and the HCBC environment

In this chapter, the use of mobile devices (as an ICT solution), are investigated. Related research on m-Health in the healthcare industry and in the HCBC context is reported.

Chapter 5: Case study results and discussion

This chapter discusses the results of the interviews and the observations. The findings of the literature review, observations and interviews conducted to identify the factors are consolidated in a list presented in this chapter.

Chapter 6: Conclusion

The research done for the research project is concluded and summarised.

1.10 CONCLUSION

Chapter 1 has addressed the background to the research study and the problems that this research aimed to solve through the research process that was followed.

The next chapter will discuss the research methodology in detail.

CHAPTER 2: RESEARCH METHODOLOGY

2.1 INTRODUCTION

According to Saunders, Thornhill and Lewis (2003), research has a number of characteristics:

- Data is collected systematically;
- Data is interpreted systematically;
- There is a clear purpose, which is to discover things.

In this chapter the description of the research methodology enables the reader to see that in this research, data was collected and interpreted systematically with a clear purpose in mind.

Section 2.2 of this chapter discusses the research methods used in this study. This paints a clear picture of the type of research done and what the outcomes of the research are. The theoretical underpinnings of the research are described, including the research process in section 2.3 and the research design which involves the research philosophy, approach, strategies, instruments used for data collection and analysis which are discussed in the various sub-sections of section 2.4. The case study is described in section 2.5 followed by the data analysis in section 2.6. The ethical considerations of this research are discussed in section 2.7 and the chapter concludes with section 2.8.

2.2 RESEARCH METHODS

In order for one to gain knowledge from research, a research methodology must be followed. Research methodology is defined as ‘a body of methods, rules, and postulates employed by a discipline’ (Methodology, 2010). There are three types of

methods that can be used: Quantitative, Qualitative and Mixed Methods (Creswell, 2003).

2.2.1 Qualitative research methods

Qualitative research tries to gain some understanding into the social or human problem using a complex, holistic view formed with words (Creswell, 1994). In order to gain this understanding of the social world, qualitative research has to use research methods to gather this data. Research methods are specific techniques that are used to gather data from the social world; the choice of research method rests on the research strategy chosen - which is the set of decisions that decides how the research will be designed (Pope & Mays, 2006). Case studies, ethnographies, grounded theory, narrative research, field observations and interviews are some research methods used in qualitative research to generate non numerical data (Creswell, 2003).

Qualitative research aims to get more perspective into the human behaviour and the reasons that govern that behaviour. Pope and Mays (2006) describe this type of research as being concerned with the meanings that people attach to their experiences of the social world and how they make sense of the world. Qualitative research therefore tries to understand these social phenomena according to the meanings of the people experiencing them (Pope & Mays, 2006). Distinctive characteristics of qualitative research are namely (Creswell, 2005):

- It is used in studies that require a detailed understanding of a central phenomenon or where little is known about the problem;
- The literature justifies the problem;
- Qualitative research relies on the views of the participants;
- The questions that participants are asked are broad and open so that more knowledge can be gained;
- The researcher seeks to understand the participants' experiences;
- Participants usually comprise a small number;

- The data collected from the participants needs to be interpreted by the researcher to find the larger meaning; and
- The researchers are biased and subjective.

2.2.2 Quantitative research methods

Quantitative research describes the use of numerical data to answer research questions and to meet objectives (Saunders, Thornhill & Lewis, 2003). According to Creswell (2005), quantitative research has distinctive characteristics:

- The literature used in quantitative research justifies the need for the research and identifies the direction of the study;
- The questions asked to participants are specific;
- The data collection consists of gathering numeric data, large numbers of people and using instruments with preset questions and responses; and
- The data analysis consists of statistical analysis.

2.2.3 Mixed methods

Mixed methods research is defined by Creswell and Plano Clark (2007) as dependent on philosophical assumptions that guide the direction of the collection and analysis of data and the mixing of qualitative and quantitative approaches. There are three ways of mixing the data (Creswell & Plano Clark, 2007):

- Merge the qualitative and quantitative data by actually bringing them together to come up with a result;
- Connecting the qualitative data onto the quantitative data, in this way making the quantitative data build on the qualitative data and then coming up with a result; or
- Embedding either qualitative within quantitative or vice versa so that one type of data provides a supportive role for the other.

Mixed methods research occurs when the researcher mixes qualitative and quantitative methods in his/her research. Mixing these methods allows the

researcher to take advantage of the strengths of certain methods and make up for their weaknesses. It also allows the researcher to better understand the problem as there are two views and not just one.

2.2.4 Research method chosen for this study

This research aims to bring to the fore the socio-technical perspectives related to the use of mobile devices to capture data at the point of care in HCBC. A qualitative research method that aims to understand the use of technology in a social world was therefore followed. By doing qualitative research the researcher aims to understand the view of the participants allowing the researcher to formulate their own views.

The qualitative research approach allowed the researcher to understand different aspects in the research: the home community based care environment, the health care worker as a person, the work that the health care worker does, the effects that this work has on them (social and environmental effects) and how using technology more specifically mobile devices could help improve their work, but also affect them in the execution of their work.

The research has been identified as being qualitative in nature. This now prompts the question of how the research was designed in order for the research questions and objectives to be met. This is answered in section 2.4 which is the research design section of this chapter. Before looking at the research design, the steps followed to conduct the research, i.e. the research process, is described.

2.3 RESEARCH PROCESS

In order for the research objectives to be achieved, a research process needs to be followed. When using a research process, one must decide on which steps will be taken to achieve the desired outcomes. The research process followed in this research is illustrated in Figure 2.1.

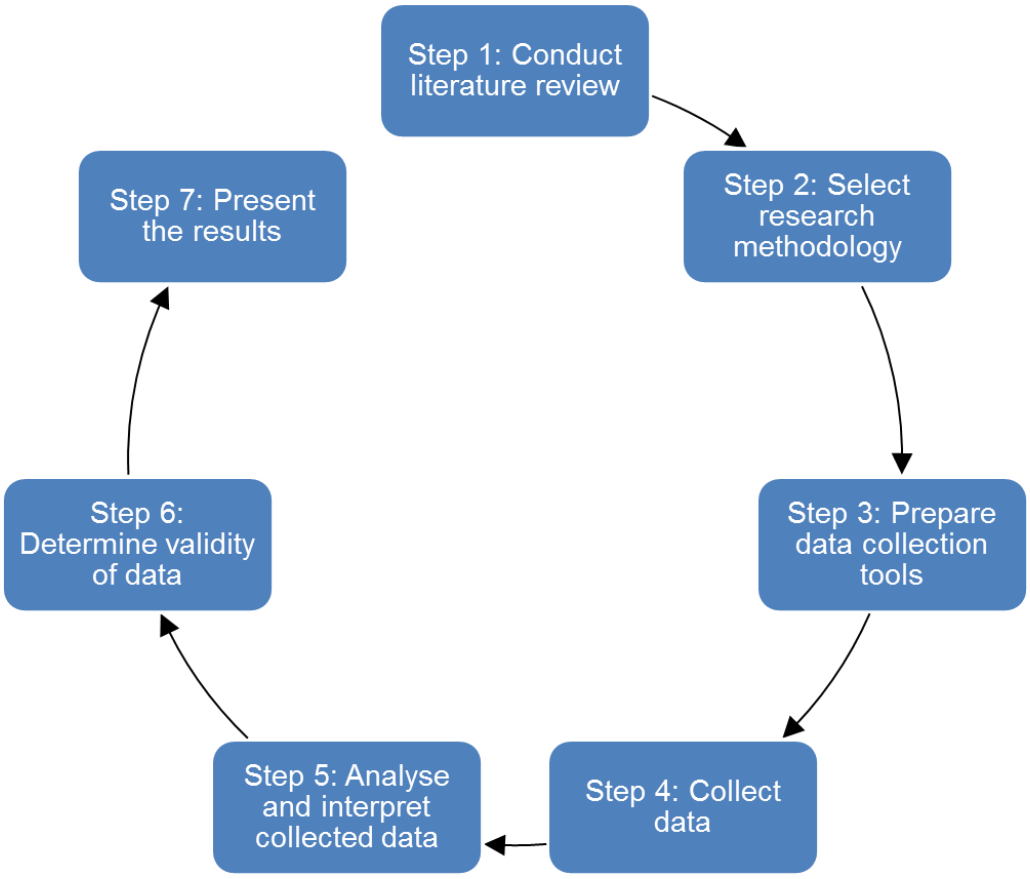

Figure 2.1 Research process of this research

The research process of the study consists of seven vital steps which are carried out to ensure that the socio-technical factors are identified.

The first step of the research was to review past literature material and studies that have been conducted that relate to this research. Once the literature was reviewed, Chapter 1 (Introduction), Chapter 3 (Health care and HCBC in developing countries)

and Chapter 4 (Mobile device in health care and developing countries) were written. The second step was to expound the research methodology. Once the methodology was known Chapter 2 (Research methodology) was written. With the knowledge gained from the literature review and a clear understanding of the path with regards to the methodology the data collection methods were prepared in step three. With the interview questions at hand and a better understanding of the case study, the health care workers were interviewed and observed in their working environment and data was collected in step 4. The interview data was voice recorded, translated and transcribed. The observation data was video recorded and field notes made. Step five involved the analysis and interpretation of the collected data. The sixth step was the verification of the factors that were identified ensuring that the data was correct and there were no anomalies. The seventh and final step was the reporting of the results from the interview, observation and literature which is a consolidation of the identified socio-technical factors. The results from the interviews and observations combined with the literature aided the researcher to understand the socio-technical factors that affect the use of m-Health in home community based care. This in turn informed the writing of Chapter 5 (Case study results and discussion).

Having explained the steps followed in this research, it is necessary to explicate the research design. The design requires the researcher to clarify a philosophy, approaches, strategies and data collection methods that will assist in accomplishing the objectives set out.

Creswell (2003) iterates that there are three questions that are central to designing research:

1. What knowledge claims are being made by the researcher?
2. What strategies of inquiry will inform the procedures?
3. What data collection methods will be used?

These three questions will be answered in the following section.

2.4 RESEARCH DESIGN

Yegidis and Weinbach (1996) affirm that a research design is a plan that a researcher follows to conduct research. The research onion (Saunders et al., 2003) depicted in Figure 2.2 is used as a guideline to determine the research design for this research. The Saunders et al. (2003) onion consists of five layers - research philosophy, research approaches, research strategies, time horizons and data collection methods. In the centre of the onion lays the data collection methods that are used to answer the research questions. Before one uses these methods, the layers of the onion need to be peeled away.

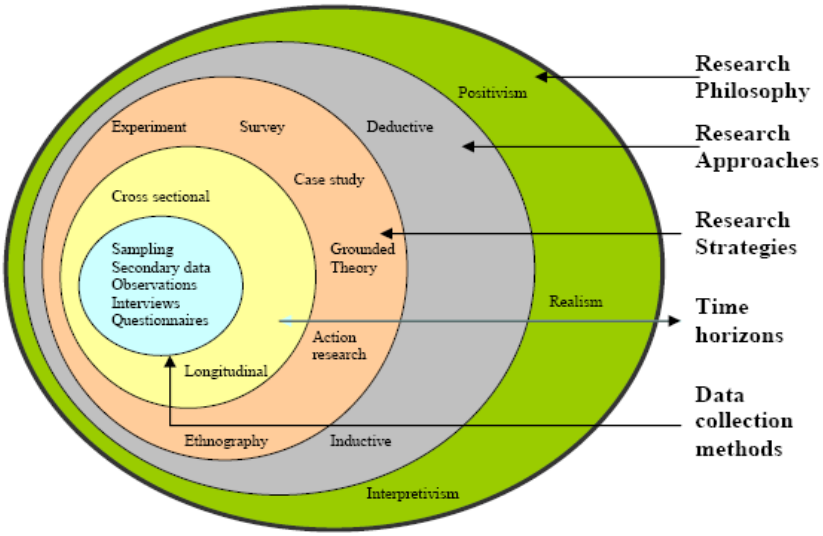

Figure 2.2 Research onion (Saunders et al., 2003)

Each of the layers depicted in Figure 2.2 are subsequently discussed as relating to the design for this research.

2.4.1 Research Philosophy

Philosophy is 'a system of philosophical concepts, a theory underlying or regarding a sphere of activity or thought, the most basic beliefs/concepts/attitudes of an individual or group' (Philosophy, 2010). According to Bassey (1990) a research philosophy paradigm is a network of coherent ideas about the nature of the world

and of the functions of the researcher; it conditions their way of thinking and underpins their research actions. It is a framework that guides how research should be conducted based on people's philosophies and their assumptions about the world and the nature of knowledge (Collis & Hussey, 2009).

There are two main philosophical paradigms: Positivism and interpretivism (Collis & Hussey, 2009). Bassey (1990) describes the way that positivist and interpretivist researchers view the world. Positivist researchers believe that there is a reality in the world that exists irrespective of people; the reality is discovered by people using their own senses and observing. Interpretivist researchers cannot accept the idea of there being a reality which exists irrespective of people because reality is a construct of the human mind; people perceive and construe the world in ways which are often similar but not the same.

2.4.1.1 Positivism

Positivism provides a framework for research in the natural sciences discipline. It is underpinned by the belief that reality is independent of us and its goal is to discover theories based on empirical research (Collis & Hussey, 2009). Positivist research is usually quantitative in nature as it uses theories, experiments and statistical analysis to answer the research questions. These methods usually produce numerical data which is then used to prove or disprove a theory.

Positivistic researchers are objective, they do not regard themselves as important variables in their research and consequently, when testing a hypothesis they expect other researchers to come to the same conclusion that they have (Bassey, 1990). Positivistic researchers seek rigorous, exact measures and objective research and they test hypotheses by carefully analysing numbers from the measures (Neuman, 2006).

There are a few criticisms about positivism that Collis and Hussey (2009) point out:

- It is impossible to separate people from the social context in which they exist;

- People cannot be understood without examining the perceptions they have of their own activities;
- Researchers are not objective but part of what they observe; and
- Capturing complex phenomena in a single measure is misleading.

2.4.1.2 Interpretivism

Interpretivism developed to address the afore-mentioned criticisms of positivism. It is underpinned by the belief that social reality is subjective because it is shaped by the researcher's thoughts and perceptions (Collis & Hussey, 2009). Interpretive researchers usually use observations and field research as data collection methods, and consequently this philosophy is regarded as qualitative in nature. These methods require the researcher to be in direct contact with the people he is studying. Neuman (2006) defines the interpretive approach as "a systematic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social world". Table 2.1 illustrates a comparison between positivism and interpretivism.

	Positivism	Interpretivism
View of the world	There is a reality that the world exists and that all the elements of the world including people will follow the rules of the world	Reality is a construct of the human mind, therefore has to have people to exist.
Role of the researcher	Do not regard themselves as part of the research. They are objective researchers.	Regard themselves as part of the research, as they are part of the world being observed.
Purpose of research	Describe and understand the phenomena of the world and to share this with	Describe and interpret the phenomena of the world in attempts to get shared

	others. By understanding, one can explain and predict the phenomena.	meaning with others. It offers possibilities not certainties of future events.
	Positivism	Interpretivisim
Data, Instruments, Method used	Qualitative data can be used for positivist or interpretivist research as is also the case with quantitative data. Data: Numerical data, verbal, non-numerical Instruments: statistical analysis, surveys, experiments, observations, interviews, case studies etc. Methods: Quantitative and Qualitative.	

Table 2.1. Comparison between Positivism and Interpretivism (Summarized from (Bassey, 1990)).

2.4.1.3 Research Philosophy for this study

In this research study, the interpretive research philosophy was applicable. An interpretive philosophy allows the researcher to have direct and meaningful interaction with the participants in their natural setting to better understand their views of the world (Bassey, 1990). It focuses on context and takes place in the natural setting of the participants instead of in a laboratory (Marshall & Rossman, 2010). In this research, the researcher was involved with observing the health workers as they carried out their daily activities in a home community based care environment. The researcher was able to be part of the health care workers' environment while they visited patients who gave consent so that the researcher could document their work and better understand the socio-technical factors affecting them. By being part of the health care workers' environment allowed the researcher to be subjective due to their level of involvement in the research. The data that was produced through the fieldwork was qualitative.

2.4.2 Research approach

A research approach determines how the researcher will conduct the research. It comprises either a deductive or inductive way of reasoning.

2.4.2.1 Deductive

A deductive research approach is considered as scientific and is predominantly used in the natural sciences because laws provide the basis for explanation in this discipline (Saunders, Lewis & Thornhill, 2003). In deductive reasoning the researcher works from the most general theories to the more specific observations, which is considered a top-down approach (Trochim, 2006). A deductive research approach is “a study in which a conceptual and theoretical structure is developed and then tested by empirical observation; thus, particular instances are deduced from general inferences” (Collis & Hussey, 2009).

In deductive reasoning, the researcher starts by having a theory from which a hypothesis is developed. The researcher gathers observable empirical evidence. The evidence gathered will then be used to test the hypothesis. Through the results of the test, this will either prove or disprove the hypothesis. This process is illustrated by Figure 2.3.

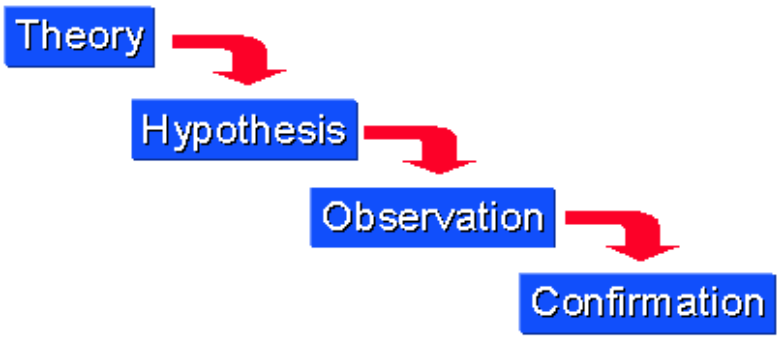

Figure 2.3 Deductive Research Approach (Trochim, 2006)

2.4.2.2 Inductive

Inductive reasoning is the opposite of deductive reasoning. Collis and Hussey (2009) define inductive research as a study in which a theory is developed from the observation of empirical reality and states that in inductive research, general conclusions are induced from particular instances. In inductive research the researcher moves from specific observations to general theories, which is known as a bottom-up approach (Trochim, 2006). To theorize in inductive research, the researcher begins with an observation and from the observations begins to detect patterns. From the patterns, a hypothesis is created which can be tested. A theory is then developed from the hypothesis. Figure 2.4 illustrates this bottom-up approach.

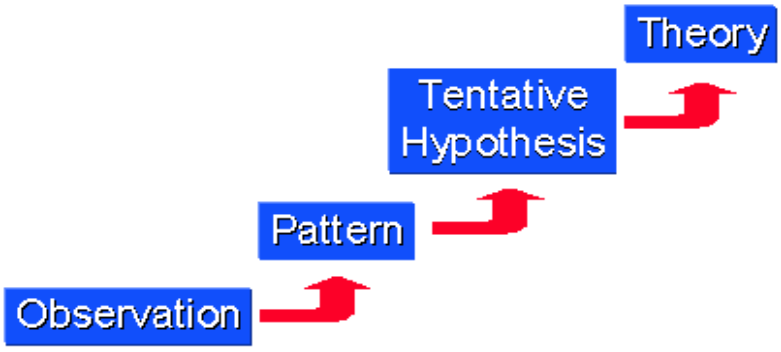

Figure 2.4 Inductive Research Approach (Trochim, 2006)

2.4.2.3 Research approach for this study

The most appropriate approach for this research study was the inductive research approach. An inductive research approach allows the research to be more open-ended and allows the researcher to be exploratory. The researcher first had to interview and observe the health care workers in their environment. From the interviews and observations patterns emerged as the researcher analysed the data to formulate the factors that are the output of this research. As this research is an interpretive study, the research concluded after identifying and interpreting the patterns (i.e. the factors) and did not create and test a hypothesis.

2.4.3 Research Strategies

A research strategy is a plan that determines how the researcher will answer the research question they have posed (Saunders, Thornhill & Lewis, 2003). The following research strategies are discussed: experiment, survey, case study, grounded theory, action research and ethnography.

2.4.3.1 Experiment

An experiment is a form of research that is used to investigate the relationship between two variables; this type of research is usually conducted in a systematic way in a laboratory or natural setting (Collis and Hussey, 2009). An experiment has three goals (Olivier, 2004):

- To see if the researcher can find something interesting;
- To test a theory; and/or
- To prove a theory.

Experiments lend themselves to the natural sciences discipline.

2.4.3.2 Survey

A survey allows the collection of primary or secondary data from a sizeable population in a highly efficient manner with the aim of analysing the data and generalizing the results to a population (Saunders, Thornhill & Lewis, 2003 and Collis & Hussey, 2009). Using a survey in a large population saves time and is not expensive. There are two types of surveys (Collis & Hussey, 2009):

- Descriptive survey. A descriptive survey is used to provide a representation of a phenomenon at one point in time or at various times.
- Analytical survey. An analytical survey's purpose is to determine whether two or multiple pairs of variables have a relationship. A theoretical framework from the

literature is required to determine which is the dependent variable and independent variable.

In order to collect the data required for the survey, questionnaires can be used.

2.4.3.3 Case Study

Collis and Hussey (2009) describe a case study as a strategy that is used to explore a single phenomenon in a natural setting using a variety of methods to obtain in-depth knowledge. Case studies are the preferred method to use when 'how' or 'why' questions are being posed; the investigator has little control over events and the focus is on a contemporary phenomenon (Yin, 2009). Key characteristics of case studies include (Benbasat, Goldstein & Mead 1987):

- A case study is examined in a natural setting;
- Data is collected by using multiple means;
- One or few entities are examined; and
- Case studies are more suitable for exploration as no experimentation or manipulation is involved.

There are two main types of case studies according to Yin (2009), viz. single cases and multiple cases. Singles cases are most suitable if the case being studied has been inaccessible to scientific investigation (revelatory case), testing a well formulated theory (critical case) and it is an extreme or unique case. Multiple cases are suitable if the research is descriptive and will be building or testing a theory (Yin, 2009).

2.4.3.4 Grounded Theory

The term 'grounded theory' was chosen by Glaser and Strauss in 1967 in order to express the idea of theory that was derived from data, systematically gathered and analysed through the research process (Glaser & Strauss, 1967). The theory is grounded in an iterative process involving the continual analysis of data collected

from concrete setting such as interviews and observations (Richardson, 1996). It generates a theory when existing theories do not address your problem and since it is grounded in the data, it provides a better explanation than any other theory because it fits the situation (Creswell, 2005). The theory is therefore developed inductively allowing it to fit in perfectly with the data which contrasts with a theory developed deductively without any data. The researcher does not start off with a theory followed by testing - instead it begins by observing the field of interest and then allows the theory to emerge from what is observed (Olivier, 2004). Strauss and Corbin (1998) state that theory derived from data is more likely to resemble reality than theory derived from speculation or experience, providing insight and understanding.

2.4.3.5 Action Research

This is a methodology that is used in applied research to find a way of bringing change in a controlled environment by entering the environment, attempting to bring change and monitoring the results of the change (Collis & Hussey, 2009). It is a form of research which involves gathering data, generating evidence from the data and making claims to knowledge based on conclusions drawn from validated evidence (McNiff & Whitehead, 2002). The term was founded by Lewin (1946) who saw the action research process as a process of cycles of planning, acting, observing and reflecting.

2.4.3.6 Ethnography

Neuman (2006) explains ethnography as a means of describing a culture and understanding another way of life from the native point of view. It requires that the researcher becomes part of the environment of the participant so that they experience this culture to better understand it. This methodology is derived from anthropology (the study of people and their customs) and is a qualitative data collection method used by phenomenologist (Collis & Hussey, 2009 and Creswell, 1994).

2.4.3.7 Research Strategy for this study

For this research study the case study strategy was selected to investigate the factors that impact the use of m-Health for remote data capturing in home community based care. A case study was used by the researcher to understand the CHCW and the socio-technical factors that impact on them while capturing data in the execution of their duties. Benbasat, Goldstein and Mead (1987) state that a case study examines a phenomenon in the natural setting and this is what the researcher will be doing: observing the health care worker in his or her own natural environment. The data required for the case study was collected by conducting interviews with six CHCWs and also through conducting observations of five of the six CHCWs. Of the five CHCWs, two were observed while they were collecting data not using mobile phones and three while they were using mobile phones.

This research required that a single case study method be used because one case study was investigated. This single case study in this research was comprised of two populations as illustrated in Figure 2.5.

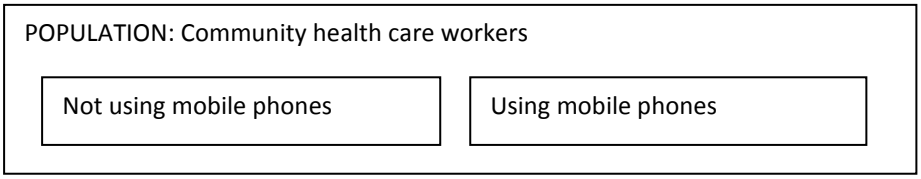

Figure 2.5 Single case study

The case study population that did not use mobile phones was investigated mainly for the purposes of understanding the HCBC context, the CHCW's daily activities and how the use of paper-based systems impacts on the CHCW's activities. The second case study population was investigated to understand the factors that affect CHCWs when they use mobile phones to collect data as part of their daily work. The case study was studied in its entirety and holistically to identify social, environmental and technical factors that are experienced in the home community based care environment.

2.4.4 Time Horizons

There are two main time horizons discussed by the Saunders et al. (2003) research onion. These are subsequently discussed.

2.4.4.1 Longitudinal

When defining longitudinal research, it must be defined according to both data and analysis methods that will be used in the research (Menard, 2002). This is a research time horizon in which the observation of subjects on a number of variables is done over a certain period of time, the data must be collected for each subject, the subjects must be analysed and be comparable from one period to the next and the analysis must involve the comparison of data between or among the periods (Ruspini, 2002 and Menard, 2002).

2.4.4.2 Cross-Sectional

A cross-sectional research time horizon involves the collection of data on more than one case at a single point in time; this data is then examined to see patterns of association (Bryman & Bell, 2007). Cross-section means a broad sampling of people of different ages, educational background, income levels, race, religion and other factors (Bailey, 1994). An example of a cross-sectional research is a census. It involves data that is collected on more than one case at a single point in time.

2.4.4.3 Research Time Horizon for this study

For this research study, the cross-sectional research time horizon was chosen. Data was collected from a case study at a single point in time and the data examined to identify patterns and similarities.

2.4.5 Data collection

Research data collection methods are methods that are used to gather the required data in order to carry out the research. There are various data collection methods, including literature reviews, interviews, questionnaires and observations.

2.4.5.1 Literature review

According to Creswell (2003) a literature review shares with the researcher the results of other studies that have been conducted that are related to the current study while highlighting the importance and need of the current study. A literature review is an argument of why the proposed research is needed in relation to what preceded it and what is happening (Denzin & Lincoln, 2011).

2.4.5.2 Interviews

An interview is an in-depth, planned and scheduled account of events of the past (Denzin & Lincoln, 2011). There are three types of interviews (Cohen & Crabtree, 2008):

- Structured interviews. In structured interviews the interviewer asks each interviewee the same questions, in the same order keeping the questions consistent with each interview. These questions are created prior to the interview and have limited responses.
- Semi-structured. The interviewer and interviewee engage in a formal interview. The interviewer develops the list of questions that need to be covered during the conversation. These questions are followed but the researcher is able to stray from the questions when it is appropriate.
- Unstructured. The interviewer has a plan in mind regarding the focus and goal of the interview. There are no structured interview questions. The interviewer allows for the interviewee to answer in a way that they can express themselves and open up. Questions are open-ended and express little control over the interviewee's responses.

Interviews can be audio or video recorded and later translated and transcribed. Even though these can be expensive and time-consuming methods, they ensure that the information collected during the interview is accurate.

2.4.5.3 Questionnaires

Questionnaires have a set series of questions that the respondent will answer. According to Bryman and Bell (2007) questionnaires have several advantages and disadvantages over interviews. The advantages of questionnaires are that they are cheaper and quicker to administer, the respondent cannot be influenced by the interviewer as the questionnaire is done in private and it is convenient because the respondent can fill it in at his own pace and at his own time. The disadvantages of questionnaires are that there is no one to help the respondents if they do not understand a question, the researcher cannot probe the respondents to elaborate on their answers and it is difficult to ask a lot of questions because the respondent might get tired and not answer all questions as required.

2.4.5.4 Observations

Observations allow the researcher to take notes on the behaviour and activities of individuals at the research site (Creswell, 2003). Observations require that the researcher be in the same environment as the participant. Through observation, the researcher better understands the participants' interaction with the environment and the technology used.

2.4.5.5 Research data collection methods used in this study

Three data collection methods were utilised to collect the data that was used in the study:

Literature Review

In this study, a literature review was conducted through the reading of books, journals, other theses and articles so that knowledge can be gained in the fields of

the health care industry, HCBC, mobile health, socio-technical theory and its application in HCBC and other contexts. The data collected from the literature review is considered secondary data as it is collected from sources that are already in existence.

Semi-structured interviews

Semi-structured interviews are less rigid than structured interviews because they allow the participants to add more questions and have more answers if there is a need, furthering the information gained from the interview. Semi-structured interviews were conducted with CHCWs. The interview questions are attached as Appendix A. The CHCWs were interviewed so that the researcher could understand the problems that they are faced with using paper-based data collection systems and also to understand the advantages (and challenges) that the use of mobile devices has brought into the HCBC environment. To record their answers during the interviews the researcher used field notes and also a voice recorder. The interview data is considered primary data as it is generated from an original source.

Observations

In this research, observations enabled the researcher to better understand the environment that the health care worker works in and to identify the socio-technical issues affecting the health care worker. The observations were carried out of CHCWs. After the interviews, the health care workers were followed and observed in the execution of their daily work in the community. With the consent of the participants, video footage was recorded. The consent form for the CHCW is attached as Appendix B. When the video footage was taken, the camera was positioned in a way to protect the patients' privacy/identification, as the focus of the study was not the patient.

The research process and design have been discussed in previous sections. The data collection methods that were used in this research have also been discussed. Table 2.2 maps the research questions and objectives to the data collection techniques to show which data collection methods were used to answer the corresponding question and achieve the relevant objective.

Research Questions	Research Objectives	Data Collection Techniques
What is the role of HCBC in healthcare provision in developing countries?	Ascertain the role of HCBC in health care provision in developing countries.	Literature review Interviews
What are the current and potential uses of ICTs, specifically mobile devices, in the broader health care and HCBC contexts?	Establish how ICTs and specifically mobile devices are used in health care, including the HCBC context.	Literature review Interviews
Which factors can be identified that impact the use of mobile device for remote data collection in the HCBC context?	Determine the factors that influence the use of mobile devices for remote data collection in the HCBC context	Literature review Interviews Observations

Table 2.2 List of secondary research questions, objectives and the data collection techniques used for each.

2.5 CASE STUDY DESCRIPTION

According to Yin (2009) and Collis and Hussey (2009), in order to conduct successful case study research, there are a number of critical steps to follow. These are discussed in sections 2.5.1 – 2.5.6.

2.5.1 Define the research questions

In this research study, the research questions have been formulated.

2.5.2 Select the case

For the purpose of this research study, a single case study was investigated. Case studies can either be explanatory, interpretive or critical in nature. Explanatory case

studies ask how and why questions that seek to deal with the operational links needing to be traced over time rather than incidences or frequencies (Yin, 2009). They seek to explain the relationship between variables by studying a situation or problem (Saunders, Thornhill & Lewis, 2003). Interpretive case studies require that the researcher not only describes and explains a phenomenon but also interprets what it means and what that phenomenon is (McNabb, 2010). A critical case study is considered critical if it exposes harmful or alienating social conditions and involves critical reflection on practices and theories (McNabb, 2010 and Myers, 2008).

In this research study the case study is interpretive in nature to allow the researcher to be able to understand and interpret the various activities that CHCWs have to do in the home community based care environment so that socio-technical factors may be identified.

2.5.3 Do a preliminary investigation

A preliminary investigation allows the researcher to better understand the case study upon which he intends on doing his research.

Research Context

Due to the demand for more health care services in response to the growing epidemic of HIV/AIDS and other chronic diseases health care workers in developing countries have to deal with an increasing number of patients requiring care at home. With the number of patients increasing, their work load is increased as well. When a health care worker visits a patient at home several forms have to be filled in, which is time consuming and less attention is paid to the patient and more to the paper work. By introducing the use of technology namely mobile devices in the HCBC context, the work load of the health care worker can potentially be decreased.

For this research two populations of health care workers were the subject of the single case study. The first population in the first case study was a group of health care workers who were not using mobile devices to aid them in their duties. The second population was a group of health care workers who used mobile devices in

their daily activities of aiding patients and capturing data. The second population was a subset of the first population of health care workers.

In section 1.2 problems experienced with the use of paper-based systems were discussed and the fact that the use of mobile devices is deemed advantageous. However, the introduction of a technology-based data capturing mechanism (like a mobile device) would need to be introduced into HCBC with due care, taking a socio-technical rather than a techno-centric approach. The adoption of a socio-technical perspective is more appealing because it encompasses both the technology and the social and environmental factors.

Research Population

A full set of cases from which a sample is taken is known as a population (Saunders, Thornhill & Lewis, 2003). Merriam Webster Dictionary further describes population as a group of individual persons from which samples are taken and a body of person having a quality or characteristic in common (Population, 2010).

As discussed earlier a single case study with two populations is investigated. The first population is where the health care workers are not using any technology and the second population is where the CHCWs are using technology. The research study was conducted in South Africa, Eastern Cape, Port Elizabeth in the township of Motherwell. The research was conducted in the Emmanuel Haven which runs a home community based care programme in this township. The population that the research was interested in was health care workers who were part of the haven at the time and were providing home base health care services to patients.

Sampling

Sampling is the selection of a smaller set of cases that a researcher selects from a larger pool (Neuman, 2006). The sampling technique that was followed is the non-probability sampling technique as the probability of each case being selected from the total population is unknown (Saunders, Thornhill & Lewis, 2003). A non-probability sampling technique is further classified into two different types: accidental and purposive sampling. In this research, purposive sampling was used. Saunders,

Thornhill and Lewis (2003), state that purposive sampling allows the researcher to select cases that will best enable the researcher to answer the research questions and meet the objectives. The purposive strategy that was used to select the participants was homogeneous sampling which focuses on one particular subgroup in which all the sample members are similar (Saunders, Thornhill & Lewis, 2003). In this research study the participants were similar in that they were all health care workers who were part of the Emmanuel Haven.

The sampling type used to choose Emmanuel haven was convenience sampling because the haven and Nelson Mandela Metropolitan University already had an existing relationship. It is also closely located to the researcher and therefore no additional travelling was required. Purposive sampling was also used as the NGO does home community based care and for the research the case study had to be conducted in this type of environment.

2.5.4 Collect the required data

The data that was collected was qualitative in nature and was collected using interviews and observations. The interview questions have been attached as Appendix A and the results from the interviews and observations are discussed in Chapter 5.

2.5.5 Analyze the case study data

Within-case analysis, cross-case analysis or holistic-case analysis can be used to analyse case study details (Collis & Hussey, 2009 and Creswell, 2007). The within-case analysis requires that you firstly become familiar with the material before building up separate descriptions of events, opinions and phenomena which can be used to identify patterns (Collis & Hussey, 2009). The cross-case analysis requires that you draw out any similarities or differences to help you identify common patterns (Collis & Hussey, 2009). The holistic-case requires that the researcher examines the entire case study and presents interpretations related to the whole case (Creswell, 2007). In this research a single case study was investigated, therefore within-case

analysis was applied. The researcher first worked through the data gathered, before working on a structure (or codes) to be used to identify patterns.

The three sub-systems of socio-technical theory as described in section 1.2.7 (Baxter & Sommerville, 2008) are used as the theoretical lens to classify the factors that are distilled from the research data as social, environmental or technical factors.

2.5.6 Evaluation of interpretive research

In order to ensure that the data collected from the case study was understood and interpreted correctly, the seven principles of hermeneutics were followed to evaluate the interpretive case study. Myers (2008) describes that hermeneutics is primarily focused on the meaning, understanding and interpreting of qualitative data, especially data that is in text format. The main purpose of hermeneutics is to aid human understanding to interpret what a particular text means and to help the researcher produce an authentic and credible story from the text (Myers, 2008). The seven principles of hermeneutics are listed by Myers (2008) as:

- Principle 1: The fundamental principle of the hermeneutic circle;
- Principle 2: The principle of contextualization;
- Principle 3: The principle of interaction between the researcher (s) and the subjects;
- Principle 4: The principle of abstraction and generalization;
- Principle 5: The principle of dialogical reasoning;
- Principle 6: The principle of multiple interpretations; and
- Principle 7: The principle of suspicion.

The definition and application of the seven principles will be discussed in the conclusion chapter of this research.

2.5.7 Report on the results found

Once all the data had been gathered and analysed the results from the case study were used to inform Chapter 5, which is the chapter that addresses the identification of the socio-technical factors.

2.6 DATA ANALYSIS

The data gathered in this research is qualitative in nature and therefore a qualitative data analysis technique was adopted.

2.6.1 Content analysis

Qualitative content analysis was used as the analysis technique to analyse the data gathered. Qualitative content analysis can be defined as the research method for the interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns (Hsieh & Shannon, 2005). Codes are tags that are used for allocating meaning to information and are usually attached to words, phrases, sentences or whole paragraphs (Basit, 2010). According to Hsieh and Shannon (2005), there are three types of qualitative content analysis techniques:

2.6.1.1 Conventional content analysis

Conventional content analysis is usually used with a study design where the aim is to describe a phenomenon and where existing theory or research literature on the phenomenon is limited.

2.6.1.2 Directed content analysis

A directed content analysis is usually conducted if existing theory or prior research exists about a phenomenon but is incomplete or could benefit from further description.

2.6.1.3 Summative content analysis

Summative content analysis starts with identifying and quantifying certain words or content in text with the purpose of understanding the contextual use of the words or context and this quantifying is an attempt to explore usage of the text.

2.6.1.4 Content analysis for this study

For this research study the directed content analysis technique was chosen, as the phenomenon of this research study already has some pre-existing knowledge and theory (even though limited) which through this research can be widened. Therefore a directed coding process is used to identify and code the factors. The directed coding process entails the following five steps (Hsieh & Shannon, 2005):

Step 1: Read all the transcriptions carefully and get a sense of the whole.
Step 2: Highlight text that appear to fit into categories.
Step 3: Code each of the highlighted text into predefined codes from the existing literature.
Step 4: If text could not be coded into one of the predefined codes, new codes are created.
Step 5: After coding, the categories and codes are examined to determine if sub-categories cannot be formed.

The interviews that were conducted with the six CHCWs were translated and transcribed. These interview transcriptions amounted to a mass amount of words which the researcher needed to analyse to identify various themes and relationships. During the observations, field notes were made by the researcher. Video recordings were made during the observations and during data analysis the video recordings were watched by the researcher and additional notes of the video recordings were made. The interview transcriptions, field and additional notes are considered the qualitative data.

Table 2.3 shows how the directed coding process was adopted and applied to the interview and observation data.

Steps	Directed coding process: interviews	Directed coding process: observation
1	The interview transcriptions were all read to get a sense of all the data.	The field and additional notes were read to get a sense of the data.
2	Text that appeared to be factors that could affect the CHCW when they are collecting patient data was highlighted.	In the field and additional notes the factors that could affect the CHCW while collecting patient data were highlighted.
3	The highlighted text was coded into the predefined codes based on literature as reported in Chapters 3 (section 3.5.2) and 4 (sections 4.4.1 and 4.4.2).	
4	All the text that did not fit into the already predefined codes, were given new codes which were implemented in the rest of the text.	
5	Attempts were made to reduce the list of codes through the use of grouping where possible. A socio-technical lens was applied for reporting purposes through grouping the codes into social, environmental or technical factors.	

Table 2.3. Directed coding process for interview and observation data

2.6.2 Reliability and Validity of the results

Lincoln and Guba (1985) propose four criteria for judging the validity of qualitative research. These four criteria are credibility, transferability, dependability and confirmability. Trochim (2006) describes each of the criteria as follows:

- Credibility. This involves establishing that the results of the qualitative research are credible from the perspective of the participant. It is the alternative to internal validity in quantitative research. The participants are the only people who can judge the credibility of the results.

- Transferability. This refers to the degree to which the results of the research can be generalized to other contexts. This is an alternative to external validity in quantitative research.
- Dependability. This is the quantitative alternative to reliability and refers to the research's ability to produce the same results if observed more than once. It also refers to the researcher's need to account for the ever changing context within which research occurs.
- Confirmability. Referred to as objectivity in quantitative research refers to the ability to which the results could be confirmed by others.

The four criteria are applied as follows in the research to ensure that the research is reliable and valid:

Credibility	- To ensure credibility of the data collected, there was a debriefing session after each interview which allowed the researcher and CHCW to discuss the data that was collected and to verify if all that was said is sufficient and valid. - Six CHCWs were interviewed to ensure that there is more than one view of the CHCW's daily data collection duties.
Transferability	- In order to ensure that the study results are transferable the research methodology and context are explained thoroughly and in detail to facilitate transferability of the results (or aspects thereof) by other researchers.
Dependability	- In the study the researcher did extensive interviewing with the six CHCWs to ensure that all required data was gathered. - Through the observations, the researcher was exposed to the field for an extensive period resulting in an in-depth understanding of the CHCW's environment and dependability of the data.
Confirmability	- In order to allow for the data to be confirmable the results of the study are sufficiently discussed in Chapter 5 to allow for other researchers to be able to replicate the results if

	necessary.

Table 2.4 Reliability and validity of the study

2.7 ETHICAL CONSIDERATIONS

This research required interaction between the researcher and the CHCW. Information disclosed by CHCWs was protected and used accordingly. Before health care workers participated in this research study, they were given consent forms to sign. The consent forms clearly stated that participation in the study is voluntary and if at any time the health care worker does not want to participate in the study, they are free to go. The consent forms are attached as Appendix B. Ethical approval has been received for the research.

2.8 CONCLUSION

This chapter focussed on describing the research design and process that were followed by the researcher to gather the required data to ensure that this research study was done correctly. The research onion was explained in detail, laying out the research philosophy, approach, strategy, time horizon and data collection methods that the researcher used. The case study was discussed in detail, considering the research context, population and the sampling of how the case and participants were selected. The ethical considerations for this research were discussed. Participation in this research study was completely voluntary therefore if the health care workers found themselves uncomfortable being interviewed or observed they were free to stop participating in the study. Figure 2.6 summarizes the research design.

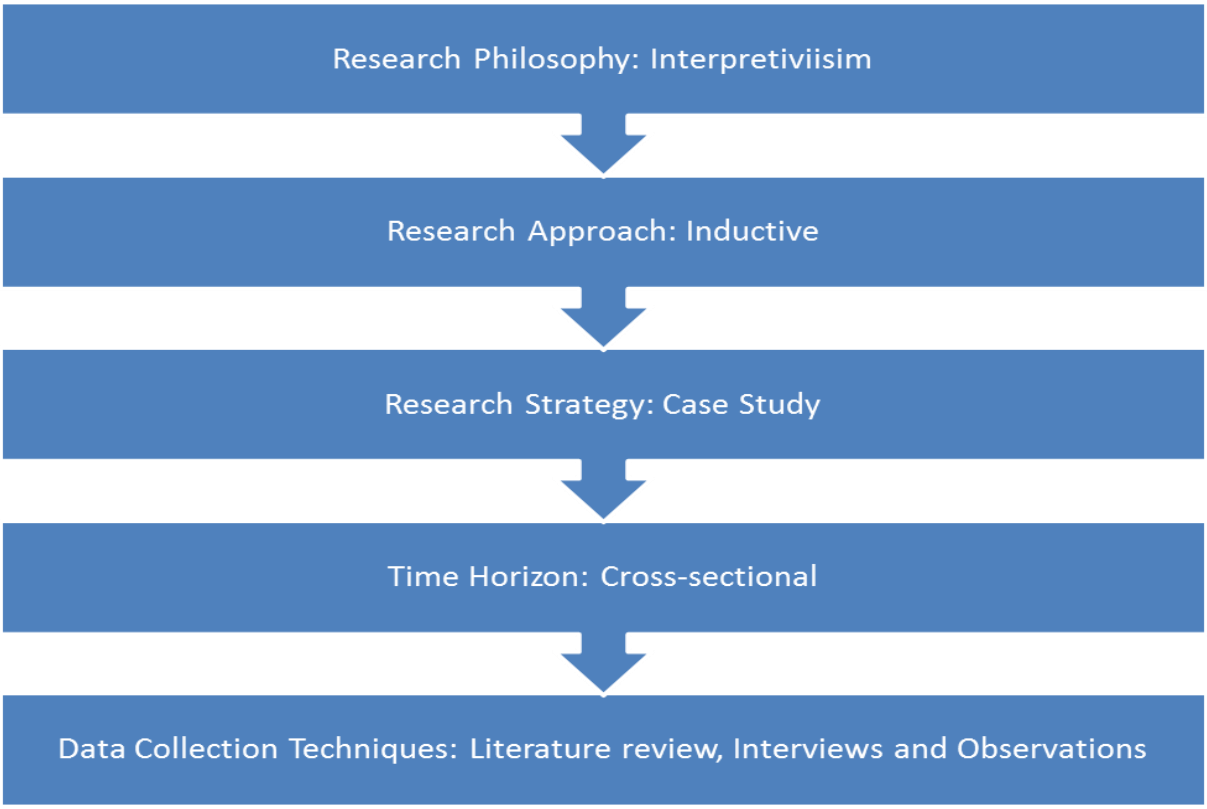

Figure 2.6 Summary of the research design

The next chapter discusses the role of health care and HCBC in developing countries and what challenges they are faced with.

CHAPTER 3: HEALTH CARE AND HOME COMMUNITY BASED CARE IN DEVELOPING COUNTRIES

3.1 INTRODUCTION

In Chapter 2, the research design and process for this research study were expounded. In Chapter 3, the literature relating to health care and home community based care in the context of developing countries is discussed. Section 3.2 of this chapter considers the definition of a health care system because according to Van Rensburg (2004), there are two very different definitions that could be used to define health care systems. Of the two definitions, the most appropriate one for this research will be identified and motivated.

The state of health care in developing countries is discussed in section 3.3 to give an understanding of how this differs from that of developed countries. Through the realisation that health care systems of developing countries could not cater to the growing demand brought on by the epidemic of HIV/AIDS, home community based care was introduced to try to reduce the pressure experienced by the health care systems in these countries. The role that home community based care plays in developing countries is subsequently discussed in section 3.4 and the role of the CHCW thereafter in section 3.5.

In order to contextualize the case study for this research project the South African health care system is analysed and discussed in section 3.6 of this chapter. This analysis will aid the reader in understanding health care, the home community based care environment and the CHCW in the context of the South African health care system.

For the analysis of the South African health care system, the following will be covered:

- The type of health care system in place;
- A comparison of the private and public health care sectors;
- Non-governmental organizations and the various types that exist; and
- A brief history of CHCWs.

The chapter concludes with section 3.7.

3.2 HEALTH CARE SYSTEMS

The definition of a health care system can sometimes cause confusion; therefore clarity is needed. A health care system can be defined according to two different meanings (Van Rensburg, 2004):

> "Health care system is an institution of health service delivery to promote, protect or restore the health of individuals and population."

Or

> "Health care system is more than just an institution of health service delivery to promote, protect or restore the health of individuals and population; it also includes aspects surrounding and influencing the health services such as housing, nutrition, sanitation and education. In the broader sense it encompasses activities falling beyond the general scope of health that affect the health of a population."

The second definition which encompasses not only the health service delivery but also the aspects surrounding the health services and the influences these might have on the health services is the most relevant for this research study. This definition of a health care system is chosen as it relates appropriately to the home community based care environment. The definition explains that a health care

system is not just about providing a health care service but also looking at the environment that the patients live in ensuring that it will have a positive impact on their health by restoring it to a better state. A health care system provides health to patients but should also help the patients sustain their health through recognising whether they have the necessary entities such as proper housing, good food and proper sanitation. The home community based care environment strives to ensure that, along with providing home care, the patient has the above entities that are required of a good health care system. This is explained in more detail in section 3.4.

Health care systems are made up of various components. The various health care system components deal with: who pays for the health care; who provides the health care services and benefits; who makes the decisions and who owns the institutions of health care. The various health care components will be discussed subsequently.

3.2.1 Health Care System Components

Van Rensburg (2004) delineates and discusses the health care system components of the South African health care system. This is relevant to the research conducted as it is focused on the health care systems of developing countries and the case study in this research is conducted in a community in South Africa that is similar to developing countries. The health care system components are discussed as follows (Van Rensburg, 2004):

3.2.1.1 Financial-economic Component

This component refers to the ways in which financial and economic matters are organized i.e. how health services are paid for and how they are financed.

3.2.1.2 Human Resource Component

The human resource component is the personnel that operate the system which includes the health care professionals.

3.2.1.3 Political-administrative Component

This component is responsible for the regulation and organization of the health care system. This includes policies, legislation and decision-making.

3.2.1.4 Cultural Component

The cultural component is a diverse component. For example a health care system in one country could include modern, traditional or alternative types of health services provision to people.

3.2.1.5 Care Component

The care component is the component which describes how care is actually given in the health care system. This includes the types of health services the health care system can provide, e.g. ambulance services and the care context in which the health care takes place, e.g. hospitals and clinics.

A health care system, regardless of which country it belongs to, needs these components in order to be effective. The health care components as listed by Van Rensburg (2004) can be represented diagrammatically as follows in Figure 3.1.

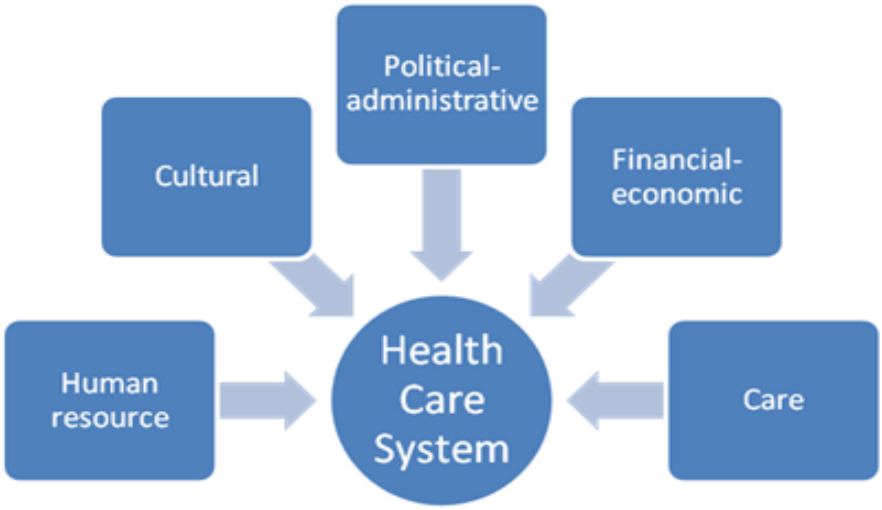

Figure 3.1 Health Care Dimensions

The financial-economic component of any health care system in any country depends on that country's political and economic status (Van Rensburg, 2004). This influences the effectiveness of the health care system and how it works for the people. In order for people in developing countries to gain positively from the health care system, it must be ensured that the health care systems of these countries are comprised of the components listed above. Furthermore, each of the components must be able to serve their intended purpose effectively and efficiently. This will in turn provide a back bone to make the health care provided in developing countries strong and satisfactory to the users as the health care that is provided will be of value to the citizens. Therefore with a strong health care system in place that comprises of the above components, health care in developing countries could improve.

3.3 HEALTH CARE IN DEVELOPING COUNTRIES

Health as a human right is stated in the constitutions of many developing countries. However, as stated by Hall & Taylor (2003), these are not enjoyed by all of its citizens; especially the right of good health, seeing that health care in developing countries has not improved since the Declaration of Alma-Ata was created. Health care in many countries is provided jointly by the government and the private sector. However, public health institutions are the only hope for the poor underprivileged people who cannot afford private health (Thomas, 2009).

There is no one internationally recognized definition of 'developing country' but there are different ways of distinguishing a developing country from a developed country. The World Bank uses one such criterion which is classifying the countries according to their gross national income (GNI) (World Bank, 2010). It classifies countries into four income groups namely: low income, lower middle income, upper middle income and high income. In order to determine in which income group a country belongs, a country's economy can be categorized according to the 2009 GNI:

- Low income. GNI per capita of $995 or less;
- Lower middle income. GNI per capita of $996 - $3,945;

- Upper middle income. GNI per capita of $3,946 - $12,195; and
- High income. GNI per capita of $12,195 or more.

These income groups are used to determine whether a country can be labelled as developed or developing. If a country falls into the ‘low income’ or ‘lower middle income’ group, the World Bank classifies this country as being developing. If a country falls into the ‘upper middle income’ and ‘high income’ group, it is defined as being developed. According to this classification using income groups, Sub-Saharan African countries are classified as developing countries as their combined GNI per capita was $1,126 in 2009 (World Bank, 2011c). Even though South Africa’s GNI of $5, 760 places it in the upper middle income group, the country is still considered as a developing country because it is in Sub-Saharan Africa and the combined GNI of Sub-Saharan Africa is in the lower middle income range (World Bank, 2011b).

Financial and economic disadvantages in developing countries have resulted in health care per capita spending in developing countries that is significantly lower than that of developed countries. Health expenditure per capita is defined by the World Bank (2011a) as:

> “The sum of public and private health expenditures as a ratio of the total population, it covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation”.

In South Africa in 2006, the health expenditure per capita was recorded as US $ 467 while for a developed country such as United States of America it was recorded at US $ 6931 (WHO, 2011). The low spending per capita on health care in developing countries causes the health care systems to underachieve. In developing countries, the financial-economic state is volatile and therefore the health expenditure per capita of developing countries is low (World Bank, 2011a). Table 3.1 shows the total health expenditure on health per capita of a selection of developing and developed countries.

Country name	Health expenditure per capita (current US$)		
	2006	2007	2008
Developing Countries			
Botswana	$362	$372	$392
Cameroon	$47	$54	$67
Nigeria	$67	$74	$90
South Africa	$467	$497	$464
Developed Countries			
Australia	$3,352	$3,986	$4,301
Belgium	$3,568	$4,056	$4,589
Sweden	$3,924	$4,495	$4,767
United States of America	$6,931	$7,285	$7,536

Table 3.1. The total expenditure on health per capita at average exchange rate that was spent in developing and developed countries in 2006, 2007 and 2008 (WHO, 2011).

From 2006 until 2008 there has been an increase in the expenditure on health in all of the selected developing countries except in South Africa as shown in Table 3.1. Data over a longer period is required though to do a proper trend analysis.

With the health care spending being so low, it is difficult for individuals of these developing countries to have access to proper health care. Apart from the financial constraints, developing countries face other challenges. Poverty stricken areas usually lack water, sanitation and proper housing. People living in these areas are most likely to fall ill as they do not have proper water to drink; they have to live in housing that is inadequate with no proper toilets. This unsavoury environment can bring about numerous diseases that can cause people to fall sick easily. The people in these developing countries also lack proper education which makes it difficult for them to improve their living conditions, ultimately making the cycle of living in poverty unbreakable.

In addition to the afore-mentioned challenges, the impact of HIV/AIDS on health care in developing countries is significant. In 2007, there was a reported 33 million people living with HIV/AIDS globally and Sub-Saharan Africa accounted for 67% of those people (UNAIDS, 2008). That is approximately 22 million people living with HIV/AIDS in Sub-Saharan Africa. With these figures in mind, the health care systems of developing countries such as the ones in Sub-Saharan Africa were not sufficient to cater for this growing demand. Home community based care was introduced to alleviate the burden on the public and private sector health care of developing countries.

3.4 ROLE OF HOME COMMUNITY BASED CARE IN HEALTH CARE

HIV/AIDS is a devastating reality in most African countries. The related health care needs of people living with HIV/AIDS have increased the burden on the healthcare systems of developing countries. From 2001 to 2009 the number of people infected with HIV/AIDS has grown from 20.3 to 22.5 million in Sub-Saharan Africa (UNAIDS, 2008). With such hard-hitting statistics of the growth of this epidemic, the introduction of Home Community Based Care has been encouraged as an alternative that can help alleviate this burden by providing care to a patient in his or her home. The Committee on a National Strategy for AIDS (CNSA) stated that in order for the patients that are living with HIV/AIDS to be treated completely and without any costs being wasted, care should be conducted at home in the community if possible and the patient should only be hospitalised when it is deemed necessary (CNSA, 1986).

In order for an HCBC programme to be effective Browning (2009) lists three vital points. Firstly, the HCBC programme must be planned carefully ensuring that it can cater to the needs of its patients. Secondly, it must ensure that the patient's environment is assessed to ensure that their basic needs such as having safe drinking water, food and proper shelter are met. The third and last thing is to ensure that all the services the patient and the family will require are available to them, such as Antiretroviral (ARV) treatment and health education. Once an HCBC programme

is implemented correctly following Browning's points, it can yield positive outcomes. Uys and Cameron (2003) confirm some of these positive outcomes as:

- Care is less expensive for the family as they do not have to spend money on transport;
- Home care helps the patient's family come to grips better with the illness of their family member;
- Care is personalised and patients do not feel isolated from their family; and
- Care is less expensive for the government as there are fewer people in hospitals and clinics.

3.4.1 Models of Home Community Based Care

Uys and Cameron (2003) explicate the three main models of home community based care as:

- Integrated. This model works by linking all the service providers with patients and their families in a continuum of care. It aims to build a network of support and collaboration between the patient, family, clinics, hospitals, community based organisations (CBOs) and NGOs.
- Single service. This model has one service provider such as a clinic, hospital, CBO or NGO that organizes care by finding volunteers, providing them with training and then linking them to patients and families that require HCBC. The volunteers are then responsible for the care of the patient making the burden of having to care for an ill patient less on the family members.
- Informal. In the informal model, the family members are the ones who care for the patient at home. The family member usually has no formal training and there is no support from a service provider.

Out of the three afore-mentioned models of HCBC, the most comprehensive and preferred is the integrated HCBC model. The integrated HCBC model is the preferred model as it not only provides care for the patient, but also links the family with organisations that can provide them with support, education and training.

The integrated home community based care model shown in Figure 3.2 shows that in this model the person living with HIV/AIDS and his or her family have support from a micro community. They can gain information from a hospice, CBO\NGO, clinic or hospital. The integrated model is ideal as it links all these stakeholders ensuring that there is a constant sharing of information between these bodies.

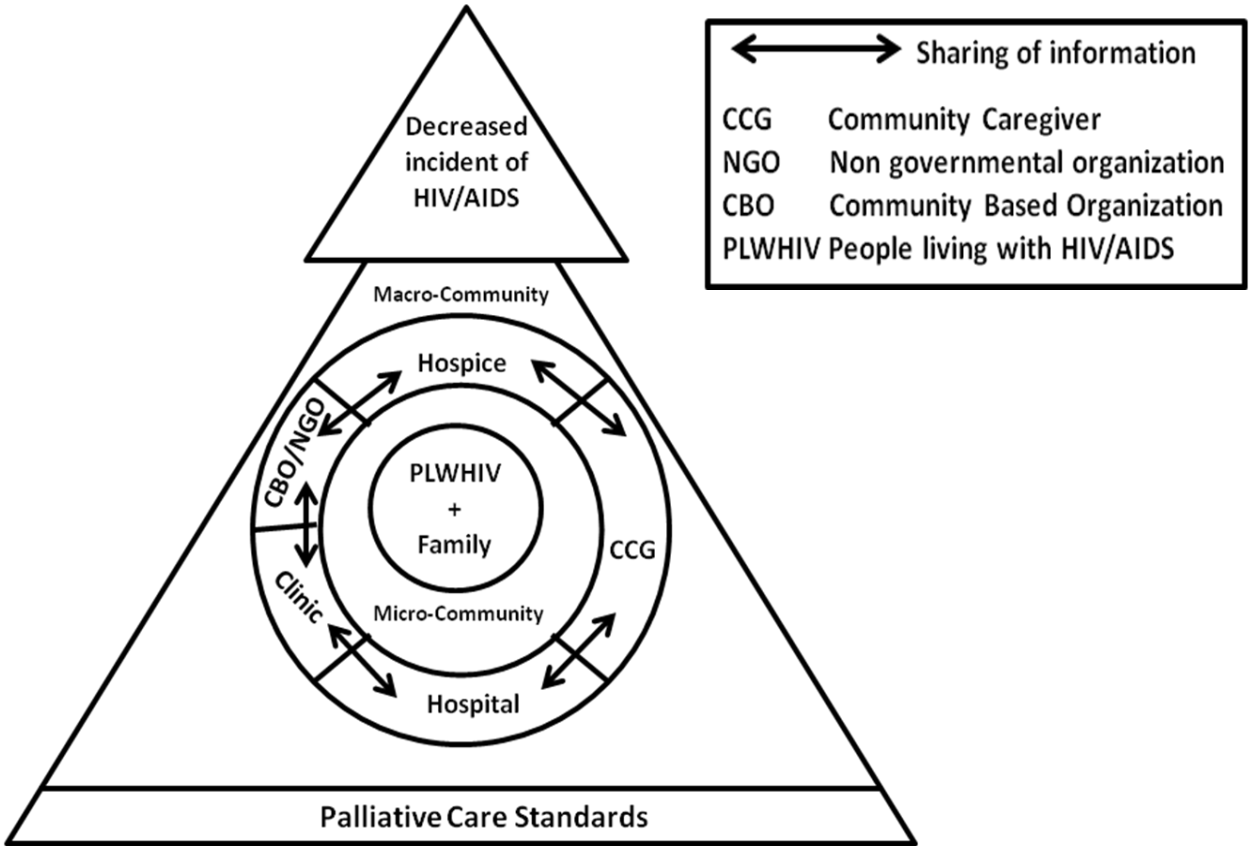

Figure 3.2 The integrated HCBC model (Uys & Cameron, 2003).

3.4.2 Challenges facing HCBC in Developing Countries

As much as there are benefits to having an effective HCBC programme, some challenges are unavoidable no matter how well planned an HCBC programme is. The main challenges and limitations facing HCBC programmes according to Browning (2009) and Shaibu (2006) are: poverty, financial constraints, fear of being associated with an HCBC programme, HCBC programmes have no support

structures for caregivers, shortage of staff in HCBC programmes and no transport for CHCWs. These will be discussed in more detail below.

The challenges described by Browning (2009) include:

- Poverty. When patients are transferred home to receive home care without the HCBC programme having assessed the patient's environment, this can affect the work and the quality of care the caregiver can give to a patient.
- Financial constraints. HCBC programmes in developing countries have little to no funding from government. They are mainly supported by NGO's.
- Fear of being associated with an HCBC programme. HCBC has been associated with HIV/AIDS. Some families refuse to have their family members enrolled in an HCBC programme because of fear of stigma.
- HCBC programmes have no support structures for caregivers. Caregivers have to deal with sick patients and get to see the poor environments that the patients live in. This can be physically demanding and emotionally draining on the caregiver. They become overworked and motivation to do their work decreases. There is no counselling program to assist them with the emotions they are feeling.

In addition Shaibu (2006) describes the following challenges:

- Shortage of staff in HCBC programmes. In some developing countries, HCBC programmes do not have enough CHCWs to attend to many patients, and as a result some patients die before being attended to.
- No transport for CHCWs. The areas that use HCBC services are usually located in remote rural areas where transport is scarce or the roads are bad. HCBC programmes in developing countries cannot provide transport to their CHCWs and the health care workers themselves do not have transport. This makes it difficult for them to visit these areas. The patient is the one that suffers as their visitations are limited.

These are the challenges that HCBC programmes in developing countries have to contend with. These challenges have an effect on the quality of care the care workers can provide to their patients. The impact of these challenges on the CHCW will be discussed in more detail in the following section.

3.5 COMMUNITY HEALTH CARE WORKERS IN HCBC

The use of community members to provide a health service to the broader community is not a new concept; their existence can be traced back to as early as fifty years ago (Lehmann & Sanders, 2007). After the declaration of Alma-Ata in 1978 established the primary health care paradigm, many countries decided to include the CHCWs in their health care systems (WHO, 1978).

3.5.1 Role of Community Health Care Workers

The definition provided by Lehmann and Saunders (2007) describes CHCWs as people who are members of the communities that they work in. They are selected by the community enabling them to play a bigger role in assisting the community and understanding the challenges they face. Before trying to understand the role and activities of CHCWs, a profile of who these workers are needs to be understood.

3.5.1.1 Profile of Community health care worker

To better understand the profile of CHCWs, the research conducted by Ofosu-Amaah (1983) and Lehmann and Saunders (2007) will be compared using the characteristics of sex, age, marital status and literacy levels in order to create a demographic profile for the CHCW.

- Sex. The two studies show that most CHCWs are females as in African communities women are the ones who raise the children and take care of the household. This makes the women to be trusted more as a caregiver as this is a natural skill to them.

- Age. The studies both showed that CHCWs were middle aged and between the ages of 31 and 50. Older women are considered to be knowledgeable while younger woman are seen as being less committed and most likely to drop out in search of better jobs in the urban areas.
- Marital Status. Most CHCWs are married. Married women are considered to be more stable and not likely to leave the job.
- Literacy levels. These surveys showed that the majority of CHCWs have either a secondary or primary education. Some have no formal education and very few have tertiary qualifications.

3.5.1.2 Role played in the community

There are various types of CHCWs such as community counsellors, home nurses, nutrition advisors, family planning advisors and village health workers. The type of CHCW that will be focused on for the purpose of this research project is the home based care givers. Home based care givers can either be formal or informal. The informal caregiver is usually the family member (such as mother, father, sister, brother or extended family such as aunts or grandparents) who cares for the patient. They are known as the primary caregivers as they are the ones who spend most of the time with the patient. The formal caregiver is usually a community member who has been trained to assist and support the primary caregiver in caring for the patient (Uys & Cameron, 2003).

In this research project the focus will be on formal home based care givers, which will be referred to as the community health care worker. According to the South African Department of Health the integrated role that CHCWs play in the community should vary from acting as advocates for the improvement of health, to being able to provide specified community-based services to the community members, transfer health and wellness skills to the community and provide referrals when necessary (DOH, 2009).

CHCWs can have two foci, namely generalist and specialist, each focus of which has different activities (Lehmann & Saunders, 2007):

- Generalist. These health workers have been working in the health care programs of developing countries even before the Declaration of Alma Ata. Their activities include: home visits, first aid treatment, treatment of simple and common ailments, health education, record-keeping and collecting data about important events (as cited in Ofosu-Amaah, 1983);
- Specialist. These community health workers are used to address specific health issues and their activities include: Maternal and child health, HIV/AIDS care, collecting basic health information in communities and record-keeping.

Generalist and specialist CHCWs might have different activities that they carry out in the community but they still play the same role of being a care provider to the community. As much as these generalist and specialist CHCWs might have different specialised activities that they perform, they share the same roles of being CHCWs of which Friedman (2005) lists a few: acting as advocates to improve health; providing basic counselling services; providing specialised health care services to community members; linking communities to other community service agents such as youth workers or educators and carrying out health promotional activities in order to educate the community.

3.5.2 Problems encountered by Community health care workers

Having described the resource-poor settings typified by HCBC, it can be understood that CHCWs face various challenges while trying to carry out their activities and helping members of the community. These challenges are summarized from literature in Table 3.2 using a socio-technical lens for categorization. A socio-technical approach is employed to analyse the problems that CHCWs experience by dividing the problems into social problems and environmental problems. Since no technical problems have been reviewed at this stage, they are not reflected in Table 3.2. This categorization of the social and environmental problems enables a better understanding of which problems affect the care worker directly (social problems) and which problems are brought about by the environment in which the care workers have to work (environmental problems). In Chapter 4, the technological problems are considered.

Social Problems	
Remuneration	CHCWs that are state funded have a stipulated income that they receive monthly according to how long they have been working. For health care workers not working for the state, there is no stipulated remuneration package as they are usually working for organizations that lack funding. Therefore their remuneration will depend on the income the organization is receiving. Some do get stipends but these are too small to support their families.
Emotional Stress	Many care workers experience stress as the job that they are doing is emotionally demanding. They worry about the deteriorating state of their patients and sometimes they get involved in family matters and start worrying about money issues.
Lack of education and illiteracy	Most health care workers only have basic education and this has affected their ability to be able to read and write properly. Their lack of education affects the HCBC programmes as they cannot produce the required reports.
Environmental Problems	
Transport issues	Most care workers do not have transport and have to work in rural areas. They have to walk long distances in different weather conditions.
Dealing with denial, stigma and discrimination.	Care workers have to deal with denial from a patient's family not allowing them into their homes as they don't want to be associated with the stigma of diseases. They also have to face seeing their patients being discriminated against as these families sometimes do not have the proper education about diseases.
Stereotypes	In countries like Zimbabwe cultural factors bar female health care workers from caring for male patients. As research has shown that most care workers are female, male patients end

	up suffering due to this.
Poverty	Care workers have to work in communities that are poverty stricken. This affects them as they have to work in environments that lack proper sanitation, water and food. They end up feeling obligated to help out the families with food and money.
Lack of supplies to carry out duties	Due to the lack of funding for HCBC programmes, health care workers sometimes end up not having the basic supplies to carry out their work. They end up having to improvise such as using plastic bags as gloves. At times, some patients do not have access to medication such as anti-retroviral drugs (ARV's). The health care workers end up having to recommend the use of other herbal therapies and nutritional supplements.
Crime	Due to poverty, crime is high in developing countries as people do not have jobs. For them, crime is sometimes the only way to provide for their families. Due to the lack in transportation and working in areas that lack electricity, care workers find themselves not being able to work in communities at night as they are scared that they might get attacked and travelling at night is not safe.

Table 3.2 The problems experienced by CHCWs. (Akintola, 2004; Akintola, 2008; *Caring from within,* 2008 and Shaibu, 2006).

Health care and health care systems in the context of developing countries, along with the role that HCBC and health care workers play in these countries, have been discussed. The following section provides more detail of the demographics, types of health care systems, history of CHCWs and the community health care policy framework as applicable in the South African context.

3.6 PROFILE OF SOUTH AFRICA

In order to contextualize the case study for this research project which is done at an NGO in South Africa, a profile of South Africa and its health care system is provided.

3.6.1 Demographics of South Africa

South Africa is located in the southern tip of Africa with a coastline of about 3000km's and a surface area of 1 219 090 km's (South Africa Year Book 2009/2010, 2010). It has Namibia, Botswana, Zimbabwe, Mozambique, Swaziland and Lesotho as its neighbours but its biggest neighbours are the Atlantic and Indian Oceans. It is divided into nine provinces; each of these provinces has its own legislative, premier and executive council (South Africa Year Book 2009/2010, 2010). These provinces are Eastern Cape, Free State, Gauteng, Kwazulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West and Western Cape Province. The largest of the provinces is Northern Cape while the smallest is Gauteng province. South Africa was reported as having a population of 49 991 300 in June of 2010 (Statistics South Africa, 2010). Even though Gauteng is the smallest province measuring at a mere 17 010 km^2 when compared to Northern Cape which measures at 361 830 km^2, it has the largest population of 11 191 700, while the Northern Cape has only 1 103 900 (Statistics South Africa and South Africa Year Book 2009/2010, 2010).

South Africa has four main race groups namely African, White, Asian/Indian and Coloureds. Africans account for 79.4% of the population (Statistics South Africa, 2010). Africans are further divided into smaller ethnic groups such as the Sotho (Northern Sotho, Southern Sotho and Tswana), the Nguni (Zulu, Xhosa and Ndebele), the Shangana-tsonga, Venda and Swazi. The White population is the second largest which accounts for 9.2% of the South African Population (Van Rensburg, 1992).

In 2000 statistics showed that 47.8% of the South African population lived in poverty and out of all the races, Africans are the ones that are greatly affected by poverty (Van Rensburg, 2004). There was an estimated 5,24 million people living with

HIV/AIDS in 2010 in South Africa, which is approximately 10.5% of the population (Statistics South Africa, 2010). This figure shows how much of a burden this can cause on the already fragmented health care system of a developing country.

With a clear understanding of South Africa and its people, the following section focuses on the South African context of the generic concept of a health care system, as defined in section 3.2.

3.6.2 Types of health care systems in South Africa

Health care in South Africa comprises of three aspects: a private health system, public health system and non-governmental organizations, which are classified as part of the private health system in literature. These are discussed below.

3.6.2.1 Public health care system

Green and Matthias (1997) define public health as controlled and financed through the government. In 2003/4 the public sector captured 38% of the total health sector (McIntyre et al., 2006). This means that the South African public health care sector is under-resourced and over used as it has to use this budget to deliver a health service to 80% of the population (SouthAfrica.info, 2010). People using the public health sector complain about the long waiting times, drugs not being available, rude staff, being turned away, opening times not being convenient, facilities not being clean and receiving the incorrect diagnosis (Burger and Grobler, 2007).

The public health care system is state-funded, meaning that it is free to all the citizens of South Africa who cannot afford to pay to receive medical attention. That is why the afore-mentioned complaints arise as there are many people reliant on free treatment. Some patients could end up being turned away if there are too many patients already at the health facility or if there are not enough drugs to dispense to the patients.

3.6.2.2 Private health care system

Private health refers to all non-state organisations whether profit motivated or not (Green and Matthias, 1997). The private sector of the South African health care system was introduced as a way to reduce the demand of service that faced the public sector (McIntyre et al., 2006). According to McIntyre et al. (2007), in 2003/4 the total national health expenditure on the private health sector was 62% and it catered to only 20% of the population. Comparing the statistics from the public sector with the private sector it is clear that the private sector has more financial resources, services a much smaller percentage of the population and therefore can provide a higher quality of care to patients compared to the public health sector. Burger and Grobler (2007) conducted a household survey that indicated that private health care users' main complaints were the prices that they had to pay to receive the private care. In South Africa, patients must pay out of their own pockets or join a medical aid scheme to gain access to private health care. In a medical aid scheme, a certain amount of money is paid per month depending on the extent of cover. Medical aid members may then visit private doctors and hospitals utilising the available medical aid benefits.

The private health system is divided into two parts: profit making and voluntary (Burger & Grobler, 2007). Medical aid schemes are mostly profit making, while voluntary private health is where NGO's are found. Therefore, according to this definition, NGOs are part of the private sector.

3.6.2.3 Non-governmental Organisations (NGOs)

In order for an organisation to be labelled an NGO it must possess the following five key characteristics as pointed out by Lewis and Kanji (2009):

- It must be formal. The organisation must be institutionalised in that it must have regular meetings;
- It must be private in that it must be separate from the government even if it does receive some support from it;

- It must be non-profit distributing meaning that if there is some financing being generated these finances must not be accrued by the owners or directors;
- It must be self-governing as it must have the ability to control and manage its own affairs; and
- It must be voluntary.

Services offered by NGOs

The Department of Health in South Africa (DOH, 2001) affirms that NGOs have their own responsibilities, such as: identifying community needs including financial needs and providing the required help; acquiring resources and using these accordingly; developing care plans to ensure continuity of care and supporting the CHCW. The types of NGOs that this research study is interested in are those that provide health services and home community based care programmes to communities. These NGOs have CHCWs that carry out the health services offered by the NGOs. CHCWs working under NGOs that operate in the home community based care environment usually have to provide services such as basic care (rehabilitation and hygiene), support to the patient, counselling, health education and assist in the household if required (DOH, 2001).

Types of NGOs in the health sector

NGOs operating in the health sector have the five characteristics named above and have the same common purpose of wanting to improve health conditions. Green and Matthias (1997) describe the operation of NGOs as follows as related to their operation in different geographical areas:

International NGO's operate within more than one country. This type of NGO is usually based in a developed country but operating in a developing country. A national NGOs' mandate is country-wide while community NGOs are based in the community. A national NGO is different from a community NGO as the Community NGO is informally constituted, operates solely within a prescribed sub-national locality and is run solely by members. On the other hand, a national NGO possesses both a legal entity and has professional staff. Each of these types of NGOs are capable of providing home community based care but it is usually the community

NGOs that implement this type of care as they are in the same community as the people that need the service and better understand the people and the challenges they face.

3.6.2.4 Point of entry to private or public healthcare

Two scenarios are used to illustrate what the first point of entry for primary health care in either the public or private health sector is for a patient and how these sectors network with the non-governmental organizations.

Scenario A: Public health care sector

Figure 3.3 illustrates how a patient would gain access into the public health system and eventually into a home community based care programme.

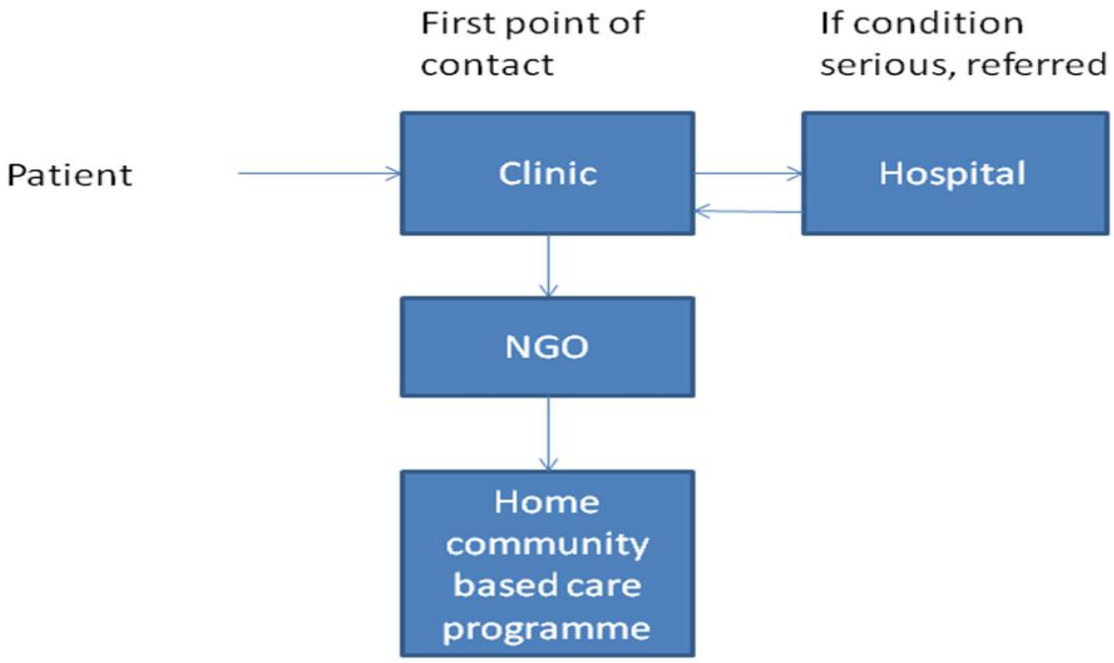

Figure 3.3 Entry point into Primary health care in Public Health Care Sector

The first point of contact into the public health care sector is the clinic (DOH, n.d). The clinic can provide services such as HIV/AIDS testing, screen for other diseases such as Tuberculosis and also administer antiretroviral drugs if necessary (DOH,

2010). Patients are usually referred from the clinic to an NGO that runs a home community based care programme due to various reasons such as: shortage of beds and overcrowding in the clinic or hospital; inadequate number of medical professionals to cater to demands of patient in the public sector and lack of resources for treatment and shortages of drugs (DOH, 2001). The home community based care programmes are utilized to lighten the burden that clinics and hospitals face.

Scenario B: Private health care sector

Figure 3.4 gives the reader an idea of what the first point of contact for a patient would be in the private health care sector.

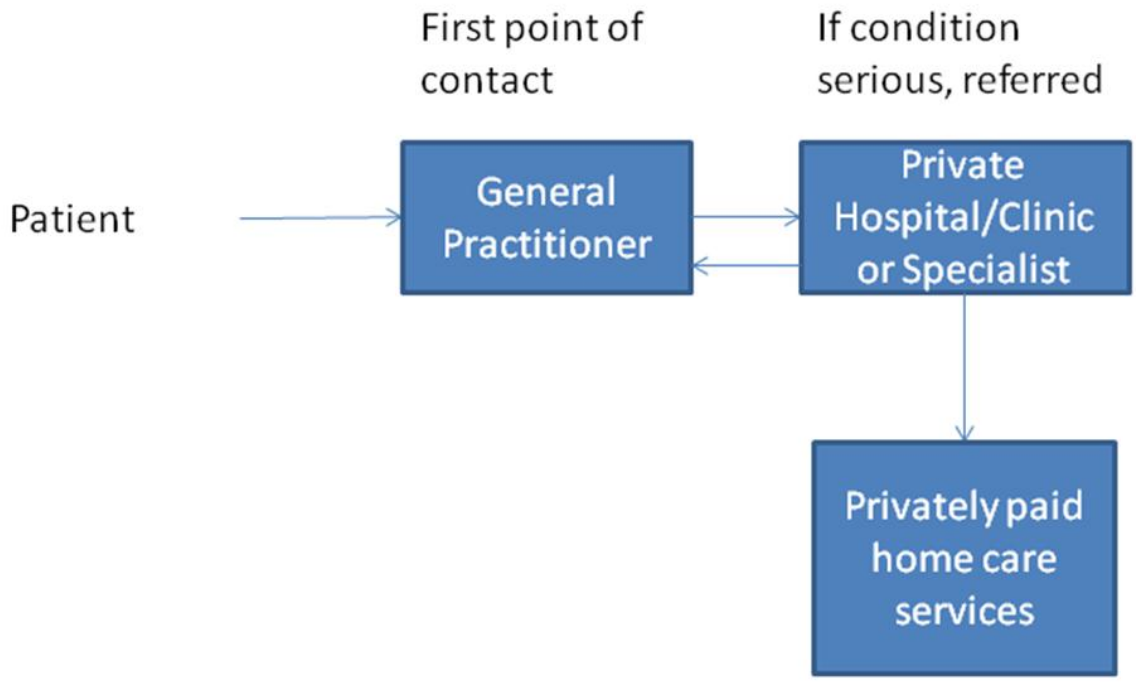

Figure 3.4 Entry point into Primary health care in Private Health Care Sector

In the private health care sector the first point of contact is with a doctor or general practitioner. The doctor can then refer the patient to a hospital or clinic if his or her condition is too serious to be treated. The private health care sector is aimed at middle and high income earners and these are usually people who are members of medical aid schemes (SouthAfrica.info, 2010). There are currently about 200

hospitals and clinics that cater for the private health sector (SouthAfrica.info, 2010). If a patient who uses the private health sector requires home care, they can receive home care from a privately paid home care service provider. This home care service will be paid for by the medical aid or out of the patient's own pocket.

3.6.3 The history of community health care workers in South Africa

In the early drafts of the South African health plan the government recognized the CHCW as an important role player in providing health services and educating the community on various health issues (Friedman, 2002). However, this would yield positive results only if they had the proper training and support (Friedman, 2002). The government could see the potential for the CHCW and the benefits they would bring. The health plan showed that if a person was to become a CHCW they could potentially make a career out of it so that they could be able to sustain themselves and their families.

After the first democratic elections in 1994 it seemed as if the health plan was no longer in existence as the new government decided not to support CHCW programmes and instead chose to support a primary health care system (Clarke, Dick & Lewin, 2008). The government was reluctant to support a national programme in 1994 but in 1996 the National Department of Health granted that CHCWs can be deployed in the provincial and district levels (Friedman, 2002). A positive break happened in 1999 when the government realised that there was an increase in patients in clinics and hospitals which was overburdening them and decided to train a large number of home based caregivers to assist in this regard (Friedman, 2005). Even then there was no policy or framework that supported CHCWs (Friedman, 2005).

3.6.4 Community Health Care Worker Policy Framework of South Africa

In 2004, a national CHCW policy framework was drafted and released; this document provided an outline of what the government's vision for a future CHCW programme was (Friedman, 2005). The creation of the Community Care Worker

Policy Framework of South Africa (DOH, 2009) has created the ability for the CHCW to be seen as an individual entity that is not threatening any role or position of other health care workers such as nurses. The vision of the policy framework is to formally manage the CHCWs as valuable role players in the delivery of home community based care services and allow for a partnership to be formed between the government and NGOs (DOH, 2009). The Department of health in South Africa (2009) discusses the Community Care Worker Policy Framework as follows:

Goals	The policy framework aims to act as a unifying policy framework for managing the health care workers; manage the services that CHCWs offer and strengthen partnerships between the government and communities.
Remuneration for the community health care worker	If CHCWs are fulltime, the policy framework stipulates that they should work a minimum of 40 hours a week and will be paid R1100 per month in their first year of work and R1500 per month from their second year onwards. If the care worker is part-time, they must work a minimum of 24 hours a month and a maximum of 80 hours a month.
Leave benefits	CHCWs are also entitled to other benefits such as annual, sick, maternity and study leave.
Requirements	The policy framework states that in order for someone to become a CHCW they need to be at least 18 years of age and meet some form of legislative determinants (for example being able to care for children).
Services provided by home community based care programmes	The home community based care programmes that are run by the NGOs must be able to provide health services such as providing information on the prevention and treatment of HIV/AIDS, promoting adherence to antiretroviral drugs, supporting the family members, assessing the family situation and providing help as required, providing referrals to hospital, assisting with the supervision of children, assisting with household chores such as washing and cleaning and they

	should be able to help the families with acquiring documentation such as birth certificates.

Table 3.3 The South African Community Health Care Worker Policy Framework

Through the government's realisation that CHCWs play an important role in society, they have become socially accepted and have become a part of communities.

3.7 CONCLUSION

In this chapter health care in the context of developing countries was discussed. It put in perspective the role that CHCWs play in home community based care environments and the role that the home community based care programmes play in the various communities that they are used in.

South African health care systems were investigated in terms of understanding the private, public and non-governmental organizations of health care. The history of and the role that CHCWs play in this country were described. South Africa has a policy framework in place that has helped with regards to CHCWs having some form of rights. The policy stipulates the number of hours the CHCWs must work, how much they should be paid and other benefits such as leave.

In order for CHCWs to do their work proficiently, they need to have the right information at hand when they need it. In developing countries, CHCWs still use paper-based systems due to the lack of growth with regards to ICTs because of factors such as lack of electricity. The possible use of ICTs in the home community based care environment is discussed in the following chapter.

CHAPTER 4: MOBILE DEVICES IN HEALTH CARE AND HOME COMMUNITY BASED CARE

4.1 INTRODUCTION

The previous chapter endeavoured to make the reader understand the state of health care, health care systems and home community based care environments in developing countries. It also created a simple profile of the key role player in the home community based care environment, which is the CHCW. The health care system of South Africa and the journey that the CHCWs have had from the early years to the creation of the CHCW Policy Framework which showed the government's vision for the future of the health care workers were discussed. With the knowledge of the health care system and an understanding of the CHCW and their working environment, this chapter aims to discuss the use of mobile devices as an ICT solution that can be used in the home community based care environment by the health care worker.

Section 4.2 discusses what mobile health is by presenting a brief definition. It also discusses what possibilities mobile health provides if it is used. Within this section the various devices that can be used for mobile health and their implementations and uses in developing countries are discussed along with why mobile devices, especially mobile phones, are appropriate for the developing country context. The mobile devices in this research would be used by the health care worker for data capturing purposes to capture patients' data at the point of care. Therefore the examples of mobile health projects that are presented in section 4.3 only focus on the use of mobile health for remote data collection in the home community based care environment. The examples are further based on literature addressing resource poor settings, to retain the developing country context. These projects are listed and discussed in sections 4.3.1 – 4.3.4 as: Community Access to Sustainable Health Programme (Ca:sh); Episurveyor; Uganda Health Information Network (UHIN) and

Cell-Life. In section 4.4 a socio-technical lens is used to analyse the projects discussed in section 4.3 to identify the social, environmental and technical challenges that have been experienced. This analysis is augmented form literature to gather social, environmental and technological challenges that have been experienced in the home community based care environment, but were not listed by the projects discussed in section 4.3. This analysis will enable an understanding of the socio-technical challenges of the use of mobile devices for data capturing in developing countries and more specifically, the home community based care environment.

The chapter will conclude with section 4.5.

4.2 MOBILE HEALTH IN DEVELOPING COUNTRIES

Mobile health (m-health) is considered to be a critical part of Electronic health (e-health) (Mechael & Sloninsky, 2008). E-health refers to the delivery of health services and information through the internet and other information and communication technologies – locally, nationally and worldwide (Eysenbach, 2001). According to Eysenbach (2001) the ‘e’ in e-health not only refers to electronic but also to themes such as: increasing the ‘efficiency’ in health care, ‘enhancing’ the quality of care, ‘encouraging’ and ‘enabling’ better communication and relationship between the patient and health professional and increasing ‘education’ of health professionals and patients on the use of e-health. The initial focus of e-health has been on the use of the internet to access health information but due to the staggering growth of mobile communication technology, e-health now encompasses mobile health (m-health).

M-health is the use of mobile phone technology to provide a health care service (Coleman, 2009). Blaya, Fraser and Holt (2010) state that mobile health provides:

- The ability for the patients to be tracked to ensure that they adhere to their medication;

- The ability to register patients and reminders to be sent to patients, reminding them of their appointments or the administering of medication; and
- The ability to collect data using PDAs, smart phones or mobile phones which can enhance research.

4.2.1 The uses of m-health communication technologies in developing countries

The use of portable devices for mobile health ensures that even patients in remote rural areas can gain access to health services as these mobile devices have the potential to create, store, retrieve and transmit health information in real time (Waruingi & Underdahl, 2009). There are various categories of mobile communication technologies that can be used for m-health for data collection. According to Mechael and Sloninsky (2008) these are: mobile phones, personal data assistants (PDAs), smart phones and mobile telemedicine devices.

In this section the capabilities of these technologies will be discussed as well as an example of how it has been implemented in the developing country context.

4.2.1.1 Mobile phones

Capabilities

The mobile phone supports a variety of functionalities with the most basic being voice and short message services (sms); some have cameras which can be used for image and video capturing (Patrick, Griswold, Raab & Intille, 2008). Mobile phones connect to a wireless network by using radio waves or satellite transmission and apart from voice and sms, some mobile phones also have the ability to provide multimedia message service (mms), web browsing, instant messaging and email capabilities (Webopedia, 2011).

The most widely used feature of mobile phones for health in developing countries is the mobile phone's sms capability (Mechael & Sloninsky, 2008). The sms capability of a mobile phone can be used for health information transmission or for data

collection purposes but it must be noted that if the sms capability is used for either of these, it must be formatted in a specific way using delimiters otherwise the receiving service will not be able to interpret the information (Coleman, 2009). A delimiter is a character that is used to identify the beginning and the end of a unit of data (Delimiter, 2011). An sms that is used for data collection would need delimiters to separate the data collected so that the receiving central server will be able to identify the different parts of the message and store the correct information in the correct columns in the database. In addition, smses can be used to promote adherence to medication via messages that are sent to patients' phones. They can also be used to collect or send information about disease and as a means of disease control.

An example of mobile phone usage in developing countries

An example of the use of sms capability is in China where it was used to deliver pharmaceutical care via smses that were sent to patients to remind them to take their medication, as well as messages containing information about drug reactions and practical information relating to the methods of administering the medication (Mao, Zhang & Zhai, 2008).

4.2.1.2 Personal Digital Assistants

Capabilities

These are small handheld devices that use a stylus (pen-based device) or keyboard to function as a phone, fax, web browser or organizer (Webopedia, 2011). According to Satellife (2005) PDAs are durable, powerful, easy to use and can function in environments where electricity is scarce through the use of solar chargers or car batteries.

An example of PDA usage in developing countries

The portability, durability, ease of use and powerfulness of PDAs were seen by Satellife (2005) as useful for the developing country context and they embarked on their use in three different African countries namely Ghana, Uganda and Kenya:

In Ghana, the PDAs were used by community volunteers to collect data from adults accompanying children to measles vaccination sites and this data was used to assess the efficiency of the outreach effort by the American Red Cross. In Uganda it was used by practicing physicians to provide them with reference material and in Kenya it was used by medical students and was loaded with content that was relative to their rotations.

4.2.1.3 Smart Phones

Capabilities

Smart phones are considered a combination of the mobile phone and the PDA; it integrates the mobile phone capabilities and the common features of the PDA (Webopedia, 2011). The smart phone is like a personal computer but with the difference of a smaller screen and keypad (Patrick et al., 2008).

An example of smart phone usage in developing countries

In developing countries, smart phones have been used to provide CHCWs and other care providers with the ability to be able to detect and treat illnesses and diseases through the use of clinical guidelines that are stored in smart phones (Microsoft, 2009). The guidelines are broken up into simpler steps that are made up of text, audio and video which the CHCWs can follow and work through while treating the patient (Microsoft, 2009).

4.2.1.4 Mobile telemedicine devices

Capabilities

Telemedicine is “the practice of medicine when the doctor and patient are widely separated using two-way voice and visual communication as by satellite or computer” (Telemedicine, 2011). Mobile telemedicine devices can be used as standalone technologies using wired or wireless telecommunications infrastructure or as add-on to mobile phones, PDAs or smart phones to transmit patient information (Mechael & Sloninsky, 2008).

An example of mobile telemedicine device usage in developing countries

In Uganda, a project was run which aimed to link CHCWs with formal health professionals through the use of walkie-talkies as this was the most cost-effective telemedicine device available (Musoke, 2002).

This section has only focused on the developing country context because this research is focused only on the use of mobile devices in resource-poor settings. A discussion of the use of mobile devices in developed countries is deemed as not necessary and does not contribute to the research. The next section discusses what makes mobile phones appropriate for use in developing countries instead of the other mobile health communication technologies which have been discussed in this section.

4.2.2 The appropriateness of mobile phones in the developing country context

There has been steady growth of mobile phone subscription in developing countries. In 2007, there were 38.5 mobile phone subscriptions per 100 inhabitants and by the year 2010 this had grown to 67.6 mobile phone subscriptions per 100 inhabitants (ITU, 2010a). This shows that the use of mobile phones in developing countries is on the rise.

Botswana has the highest mobile phone subscription with 96.12 per 100 inhabitants, followed by Tunisia and South Africa with 95.38 and 92.67 respectively (ITU, 2010b). Even though there are some African countries that have embraced the use of mobile phones, some countries have not adopted their use. Ethiopia and Liberia are examples of these countries with mobile phone subscriptions of 4.89 and 21.29 per 100 inhabitants respectively (ITU, 2010b). Interestingly, in some developed countries their mobile phone subscription per 100 inhabitants is more than 100, showing that in these countries one person sometimes owns multiple phones. However, Blynn (2009) states that in developing countries mobile phone usage could be underestimated as there is a large number of people sharing mobile phones between family and friends. The high number of people who own mobile phones in developing

countries shows that there is potential for mobile phones to be used in developing countries for mobile health purposes.

The use of technology such as a mobile phone allows for the technology to act as an instrument that will enable health professionals in developing countries to have better access to quality information which will increase their knowledge (Chandrasekhar & Ghosh, 2001). In developing countries mobile health has been used as (Mishra & Singh, 2008):

- A cost-saving way of identifying and monitoring issues related to health;
- A way to provide health professionals access to patient information;
- A way that health professionals can gain access to other information sources which they can use to enhance their knowledge and be able to diagnose and treat patients correctly;
- A means that can provide patients access to information on health issues; and
- A means that patients can use to monitor their chronic or infectious diseases and transmit the data to their healthcare provider;

The adoption of mobile health in developing countries has been shown to be evident through the discussion in section 4.2.1 of some of the mobile communication technologies that have been used in developing countries. The examples discussed show that mobile health in developing countries has been used as a way to encourage patients to adhere to their medication regime through the use of sms reminders; educate the patient about his or her medication and also relay other important health information to them; allow the health professionals to collect health information from patients; allow the health professionals the ability to gain knowledge through the use of mobile communication technology and be able to diagnose and treat a patient despite location boundaries.

Mobile health uses the popularity of the mobile phone to deliver health care services to people in developing countries. Their rapid growth and acceptance into the developing country context, especially in rural, poor and remote areas that have a lack of proper infrastructure, electricity and high illiteracy levels, could be attributed

to their ease of use and affordability in price especially for poor, rural communities in developing countries (Mishra & Singh, 2008). Health professionals and patients can reach and leave messages for each other regardless of the time of day or the location they are in. The use of mobile devices overcomes the boundaries of distance that is usually experienced in developing countries (Patrick et al., 2008). Access to information at the point of care is improved through the use of wireless technology and information is readily available to health care workers at the point of care (Mechael, 2007).

Even though m-health has been shown to be appropriate in the developing country context there are various barriers to their use in health care. Through an analysis of examples of mobile health projects that were implemented in developing countries to be discussed in section 4.3, a socio-technical analysis will be provided in section 4.4.1. This enables an understanding of the barriers for the use of mobile health in developing countries that have been identified from the examples.

With the growth of the use of mobile phones in developing countries, various projects have been created for the developing country context that use mobile phones to provide a health service to the people of these countries. The following section will discuss the various types of projects in the HCBC context of developing countries that have used mobile phones for remote data collection. The purpose of this discussion is to enable an analysis of these projects to summarise the social, environmental and technical barriers that have been experienced to the use of mobile phones in HCBC. This socio-technical analysis is presented in Section 4.4.1.

4.3 EXAMPLES OF MOBILE HEALTH PROJECTS FOR REMOTE DATA COLLECTION IN THE HOME COMMUNITY BASED CARE ENVIRONMENT OF DEVELOPING COUNTRIES

In Chapter 1, section 1.2, the various categories within which mobile devices can be used for mobile health were discussed. Vital Wave Consulting (2009) lists the categories as: education and awareness; remote data collection; remote monitoring;

communication and training for health care workers; disease and epidemic outbreak tracking and diagnostic and treatment support. In this section, only examples of projects that can be categorised in the remote data collection category are discussed. The projects focus on the home community based care environment in developing countries and using mobile phones for remote data collection. For each project discussion the following structure will be followed:

- Brief background of where and when the project was piloted or tested;
- The main objective or aim of the project;
- How the project was used and who was involved in the project;
- Any advantages of the project; and
- The challenges and problems that were faced during the pilot or when the project was in full operation.

4.3.1 Community Access to Sustainable Health Programme (Ca:sh)

The Ca:sh programme was started in India in a rural community with a population of 70000 in 2001 (Iluyemi, 2009). The aim of the Ca:sh programme was to collect medical and demographic data from the community since it was realised that rural areas often lack the ability to collect health and population data effectively (Vital Wave Consulting, 2009). The Ca:sh programme used handheld computers to efficiently collect data and allowed health care workers instant access to a patient's record during a home visit (Ca:sh, 2010). Once patient information was collected, it could be exported to a removable data storage card and sent to the nearest hospital or clinic for further analysis and archiving (Ca:sh, 2010).

Advantages of the Ca:sh programme are the following: the use of removable data storage cards acts as backup media to the data that is in the device, the entire database is in the device, ensuring that data can be accessed easily and efficiently and it ensures minimal entry of data by providing a virtual keypad for data entry.

Problems

According to Iluyemi (2009), despite the programme's success, the Ca:sh programme was discontinued due to a lack of support from the government. Adequate financial support is necessary to ensure success and for the Ca:sh programme funding issues were experienced (Anantraman et al., 2002). Dimagi (2011) states that the Ca:sh programme is only compatible with the Linux operating system, meaning that if your mobile phone does not support the Linux operating system it will not work.

4.3.2 Episurveyor

The aim of Episurveyor is to allow anyone to create, share and deploy surveys and other forms that can be used for data collection on mobile devices (Vital Wave Consulting, 2009). According to DataDyne (2011) Episurveyor is a website where one can create forms that can be used for data collection. The forms created on the website can then be downloaded onto mobile phones and these can be used to collect the data. Once all the data is collected it is uploaded to a remote server so that the data will not be lost and it can later be analysed (DataDyne, 2011). In Cameroon, this tool has been used by health researchers to collect information such as child nutritional status monitoring and to investigate governance at hospitals (DataDyne, 2010).

The advantages of Episurveyor, according to Vital Wave Consulting (2009), are: it is easy to use, uses open source software (making it free) and anyone can create the forms so there is no need to hire an outside consultant to create the forms.

Problems

The barriers to using Episurveyor are that it has a list of mobile phones that it can run on so if your phone is not on the list it is not compatible (DataDyne, 2011). Secondly, in order to be able to create the data collection forms, or to upload the results, an internet connection is required. In developing countries the internet connection can sometimes be unstable (Chetley, 2006).

4.3.3 Uganda Health Information Network (UHIN)

The project was launched in 2003 in Uganda (Vital Wave Consulting, 2009). The ministry of health in Uganda recognized that they needed to be able to collect and analyse information so that they could improve health and the UHIN was created to provide a computerized health management information system and also have the ability to provide e-health learning material to health care workers (Iluyemi, 2009). PDAs are used by health care workers to collect information and provide them with education (Vital Wave Consulting, 2009).

Problems

The challenges faced by the project are that there was a shortage of PDAs and health care workers ended up having to share the device (sometimes six health care workers would share one device) (Iluyemi, 2009).

4.3.4 Cell-Life

Cell-Life was started in South Africa in 2002 with the aim of being a system that combines the use of mobile technology and the internet to monitor and ensure that patients who are HIV-positive and on ARV treatment adhere to the medication. This project utilises the fact that most South Africans have mobile phones and uses this to improve the flow of information between patient, doctors and hospitals (Wilmers & Hodgkinson-Williams, 2009).

There are three remote data collection solutions that are run by Cell-Life that are used for Remote Data Collection: Aftercare, Emit (now known as Capture) and Cellphone4HIV. Aftercare is used by CHCWs who usually work with between 15 and 20 HIV-positive patients and allows the health care workers to capture patients' information (such as symptoms) and these are later uploaded to a central database (Wilmer & Hodgkinson-Williams, 2009). Emit is similar to Episurveyor as forms can be created online, downloaded onto the health care workers' phones and they can use these to collect data from patients' homes; once data is collected it can be uploaded to a central database (Emit, n.d). Cell phone 4 HIV can be used by health

care workers in the field to collect data through the use of filling in a questionnaire, survey or form; this data can then be sent to a database for analysis (Cell-Life, 2009).

Problems

The Emit software has only been tested on a few Nokia phones and it is assumed that it will work on other phones from other brands so there is a possibility that it is not compatible with all phones (Emit, n.d). According to Leach-Lemens (2009) Cellphone4HIV experienced challenges such as: financial sustainability; only being able to be used on one mobile phone network using pre-paid accounts; the software was written in English and in South Africa there are 11 official languages; this meant it would need to be translated into all official languages and this increased the scale of the project. CHCWs that had to use the mobile phones feared for their safety, feared that the mobile phone would be stolen and also that, due to the use of technology, the lines between work and personal life would be blurred (Leach-Lemens, 2009).

The following section analyses the projects discussed in this section and categorizes the problems and challenges that were faced by the projects from a socio-technical point of view.

4.4 SOCIO-TECHNICAL SYSTEMS ANALYSIS

This section develops a socio-technical analysis from two sources of information: the various examples that were provided in section 4.3 and also from other literature that has been gathered. The various mobile health projects that used mobile devices in the home community based care environment that were discussed in section 4.3 will be analysed in section 4.4.1. The factors that have been gathered from literature will be discussed in section 4.4.2. The socio-technical approach is used to analyse the problems and challenges that were experienced in the projects listed in section 4.3 and in the literature. Through the use of the socio-technical systems lens, the problems and challenges will be divided into either being social, environmental or technical factors. This analysis and categorization of the factors will allow a better

understanding of the factors that affect the health care workers directly while they use the mobile phone for data capturing purposes (social factors), what factors are experienced by the health care worker when carrying out their daily duties in the home community based care environment using the mobile phone for capturing patient's data (environmental factors) and finally what factors cause the mobile phone to not be used effectively in the home community based care environment while capturing data (technical factors).

4.4.1 Socio-technical factors from Examples

In section 4.3, various example projects were discussed and the problems and challenges experienced were also discussed. Table 4.1 tabulates the social, environmental and technical factors and also the projects that experienced these factors along with a short explanation of each factor.

	Ca:sh	**Episurveyor**	**UHIN**	**EMIT**	**Cell phone 4**
Social Factors					
Use of technology blurs the line between work and personal life The use of technology can sometimes blur the line between work and personal life due to the fact that it makes the CHCWs feel like they are taking work home.					X
Language barrier Some mobile health applications use language which is foreign to its users and this makes it difficult for CHCWs to use the device and the application.					X

	Ca:sh	Episurveyor	UHIN	EMIT	Cell phone 4
Environmental Factors					
Crime Crime in developing countries is high and this can be attributed to the high poverty rate. Health care workers fear for their personal safety when working in these environments and they fear that the mobile devices might be stolen.					X
Lack of devices A lack of devices forces the CHCW to share devices and this impacts negatively on their work.			X		
Lack of funding Financial stability: When projects are started there are issues and concerns pertaining to the financial sustainability of the project. Lack of hardware: A lack of funding can lead to a lack of mobile phones for the CHCWs.			X		X
Lack of reliable internet connection Developing countries suffer from a lack of proper infrastructure to support proper connection to the internet. Internet connection in developing countries is unreliable.		X			
Lack of support from government A lack of support from government can cause mobile health projects to fail as projects are reliant on government for various resources.	X				
Privacy A shortage of devices (and subsequent sharing of devices) raises concerns about patient information privacy and confidentiality.			X		

	Ca:sh	Episurveyor	UHIN	EMIT	Cell phone 4
Technical Factors					
Mobile health application can only run on certain phones Mobile health applications that run on certain phones can cause problems as it is not compatible with all types of phones.	X	X		X	
Mobile health application only working on certain mobile phone networks using pre-paid accounts only Mobile health applications that run on certain mobile phone networks, are problematic as only mobile devices on that network have the ability to use the application.					X
Mobile health application only runs on certain operating system Mobile health applications that run on certain operating systems cause limitations as these only allow certain mobile devices to use the application	X				

Table 4.1 Social, environmental and technical factors relating to mobile health applications

Table 4.1 illustrates the social, environmental and technical factors that have been gathered from the projects that have used mobile devices in the home community based care environment. It is necessary to supplement this analysis in table 4.1 with factors identified from literature and that have not been covered in this table. This literature identification of factors is discussed in the next section.

4.4.2 Socio-technical factors from Literature

Various factors have been gathered from literature that highlight social, environmental and technical factors that have been experienced by CHCWs in home community based care when they use mobile devices for data collection. The factors identified through literature in table 4.2 are an add-on to the ones that have been discussed in table 4.1 and therefore are not repetitions of those that have already been identified in the previous table. It is deemed necessary to discuss the literature factors to show that there are other factors apart from the ones that have been identified from the projects discussed in section 4.3.

Social Factors	
Lack of commitment	A lack of commitment from the CHCWs can result in them not attending the required training which can lead to them missing out on vital information which could prevent them from carrying out their duties effectively (Mhila et al., 2009).
Lack of skills	Due to a lack of commitment and not attending training rigorously, the CHCWs' skills will not be proficient enough to allow them to use the mobile devices efficiently.
Environmental Factors	
Lack of electricity	In developing countries like Tanzania, there is a lack of electricity in rural areas therefore CHCWs sometimes have to charge their mobile devices at local charging stations (Mhila et al., 2009). Mhila et al. note that sometimes the mobile device's batteries are swapped with fake batteries that quickly lose power by the service providers who are responsible for charging the batteries at the local charging stations (Mhila et al., 2009). If mobile

	devices lose power quickly, they will switch off and the CHCWs will not be able to perform their data capturing duties immediately.
Lack of trust (Patients)	When CHCWs visit a patient's home with different mobile devices, the patients sometimes do not trust the health care workers and think that they have given the other mobile devices with their personal information to someone else and are scared that there is a lack of privacy concerning their data (Mhila et al., 2009).
Technical Factors	
Backup issues	With the use of a mobile device for data collection, there is no trail that can be reviewed in case there is a problem in the field while collecting data (Tomlinson et al., 2009).

Table 4.2 Social, environmental and technical factors that have been found in literature and were not covered in Table 4.1

Through the analysis provided in Tables 4.1 and 4.2 various social, environmental and technical factors have been identified from the analysed projects and from various literature sources. This analysis has provided various socio-technical factors that can be experienced by health care workers while collecting data in the home community based care environment.

4.5 CONCLUSION

The use of mobile phones in health can be vast and utilized in various ways such as enabling communication between patients and doctors despite distance and time barriers, ordering and delivering drugs or supplies and identifying, monitoring and communicating any potential health threats before they become uncontrollable (Dzenowagis, 2005).

In this chapter a perspective of how mobile health is used in developing countries was provided. The appropriateness of mobile health for the developing country context, the growth of mobile phones in developing countries and the advantages of using mobile health in developing countries were discussed. A selection of projects that have used mobile health applications in developing countries in the home community based care environment were discussed. A socio-technical analysis of the factors that were experienced by the projects was provided. This analysis used a socio-technical lens to view the barriers of using mobile phones in developing countries in the HCBC context.

In the next chapter, the interview and observation results of the case study conducted at an NGO are presented and the final list of factors affecting the use of mobile devices for remote data collection in home-community based care is presented.

CHAPTER 5: CASE STUDY RESULTS AND DISCUSSION

5.1 INTRODUCTION

The previous chapter discussed what makes mobile devices and more specifically mobile phones appropriate for remote data collection in the home community based care environment. The chapter concluded with a socio-technical analysis of projects where mobile phones were used for remote data collection in the home community based care environment. A similar analysis was provided based on literature not related to the example projects. The analyses highlighted problems that face CHCWs as they use a mobile phone for data capturing in the environment. Socio-technical problems such as: lack of devices, language barriers when using the mobile device application, crime, lack of funding and lack of electricity restrict the effective use of mobile phones by the CHCW.

This chapter aims to interpret and discuss the primary data collected from CHCWs through the use of interviews and observations. A single case study was conducted at the Emmanuel Haven in Motherwell, a township adjacent to the city of Port Elizabeth in South Africa. Section 5.2 discusses the background of the case study environment. Section 5.3 discusses the data collection methods that were used. In this section the type of sampling technique employed, data gathering process and the problems that were experienced when the data collection was done are discussed. Section 5.4 discusses the results according to the social, environmental and technical aspects. This chapter concludes with section 5.5.

5.2 EMMANUEL HAVEN BACKGROUND

Motherwell is situated 20km's outside of Port Elizabeth in the Eastern Cape Province of South Africa and is made up of 15 neighbourhood units (NU's); it is home to an

estimated 187,680 people (DLPG, n.d (a)). This area is plagued with a high illiteracy level, lack of adequate health service provision such as clinics, high crime rates and poverty. More than 76% of the Motherwell population earn less than R1600 per month with at least 50% of the population being unemployed (DLPG, n.d (b)).

Emmanuel Haven is a unique community-based project with an integrated marketplace approach that is located in NU 12 of Motherwell Township. The haven currently has approximately 300 volunteer CHCWs in its capacity who go out into the community of Motherwell to provide a home based care service to patients who need it. The Emmanuel Haven has various projects that it runs apart from the home-based care initiative, which include a day care centre, shoe and brick manufacturing, crèche, radio station, computer school, farming and other various initiatives. The Emmanuel Haven is the only home-based healthcare provider in the Motherwell Township and it was established in 2004 by Dr Mamisa Chabula-Nxiweni with the primary aim of dealing with the growing number of adults and children that are infected or affected by HIV/AIDS (Emmanuel Haven, n.d).

A CHCW at Emmanuel Haven visits up to four patients on any one workday. CHCWs are not rushed to visit all their patients in one day. Instead, they are encouraged to take their time during patient visits to ensure that all the patients' needs are fulfilled. A CHCW's working day lasts from 8am until 2pm with each patient visit lasting between 30 – 60 minutes depending on the patient's condition and the duties that the CHCW has to perform. The CHCW not only provides care for their patients but also links the family with clinics, hospitals or other organizations that can provide them with support, education and training.

5.3 STRUCTURE OF DATA COLLECTION METHODS

5.3.1 Interviews

The interviews were semi-structured and open-ended allowing for the researcher to add any questions if clarification was required. Furthermore, this interview type allows the interviewees to be able to relate stories about their care giving

experiences which aided the researcher in understanding the environment they work in better. If questions are open-ended and the interview is semi-structured they give the interviewee an opportunity to talk as the questions encourage reflection. This allows interviewees to share insights which they would not have been able to share if the interview was close-ended and fully structured.

The interview questions (attached as appendix A) were divided into three aspects that affect the community healthcare worker, viz. social, environmental and technical.

The aim of each aspect is discussed below:

- Social aspect: The social aspect of the interview aimed at understanding the CHCWs better through knowledge of their demographic information and also their computer and mobile device knowledge.
- Environmental aspect: The environmental aspect aimed at understanding the working activities involved in a CHCW's day and the environmental factors they were faced with while in the field collecting the data using either paper-based systems or mobile phones.
- Technical aspects: The technical aspect intended to understand what factors were experienced by the CHCWs when carrying out their activities using a mobile phone and what advantages or disadvantages are there to using mobile phones for data capturing. In the case of when the CHCWs were using paper-based systems, the aim was to understand their perceived thoughts on the use of mobile phones for capturing data.

5.3.1.1 Sampling techniques

Purposive and convenience sampling were applicable to this research study due to the fact that the interviewees who were selected were based on their ability and availability to help the researcher answer their research questions and meet their objectives. Six CHCWs who were available and able to help the researcher were selected by the matron of the haven for the interviews. The six interviews were carried out over two days (three interviewees per day).

5.3.1.2 Structure of interviews

Interview times ranged from 40 minutes with the longest lasting 105 minutes. The interviews were conducted in private areas in the CHCWs' environment with only the researcher, assistant and the CHCW present to ensure that the CHCW was comfortable enough to answer the questions.

Before asking the interview questions, the details of the consent form (attached as appendix B) were discussed and if the CHCW was willing to participate in the research study he/she would sign the consent form and the interview would commence. The interview was recorded on a voice recorder. After each interview the researcher would switch off the voice recorder and have a debriefing session with the interviewee in which they would talk to the researcher about other comments they would like to add, which they did not want to be recorded. The purpose of the debriefing session was to enhance the researcher's understanding but this data from the debriefing discussion could not be used.

5.3.1.3 Capturing of interview results

The recorded interview data was translated from isiXhosa to English and transcribed in English. The data from each CHCW was labelled; i.e. interviewees A-F. This ensured that each interviewee would not be identifiable and would remain anonymous in the research and make it easier for the purposes of the feedback.

5.3.1.4 Limitations and problems experienced during interviews

Distraction

Even though the interviews were conducted in private, the CHCW would sometimes be distracted by other workers entering to request help from them.

Translation of questions from English to Xhosa

The interview questions were constructed in English, however, during the interviews it was realised that it was easier for the CHCWs to understand the questions in Xhosa. Therefore, the questions were asked in Xhosa when it seemed as if a CHCW could not understand the question in English.

Interview times and days
Sometimes the CHCWs are not available on certain days and therefore it was difficult to arrange the interview schedule as it depended on the availability of the CHCW.

5.3.2 Observations

The observations were carried out in the home community based care environment in which the CHCWs carry out their daily duties. The researcher observed the CHCWs as they visited patients so that their work and their environment could be understood through exposure to the actual environment. Both the CHCW and the patient had to give consent before the researcher could observe the CHCWs.

5.3.2.1 Sampling technique

Two sets of observations were carried out, one in the paper-based environment and one in the paper-less environment. The observations for the paper-based environment were carried out on the second day of the visit to the care haven after the second group of interviews were concluded. Two CHCWs were observed for the paper-based environment. The sampling that was applicable for the paper-based environment observation was convenience sampling as the CHCWs who were observed were the only ones visiting patients on the day.

Three organizations were contacted during the research to find a suitable case study environment where mobile phones are used for data collection. Unfortunately none of the organizations agreed to allow the researcher to use them as a case study. Therefore the researcher developed a mobile application with Episurveyor,

discussed in section 4.3.2, which was used in the Emmanuel Haven and five CHCWs were trained on using the mobile application.

The observations for the paper-less environment were carried out after training was concluded and three CHCWs were observed while using mobile phones to collect patient data. Convenience sampling was also applicable for the paper-less environment as the matron selected the observation participants for the researcher to observe in the home community based care environment while they tended to patients as they were the only available ones. The CHCWs who were selected were the most accessible at the time as they were the only CHCWs that were going out for home visits when the researcher was there. In total, five CHCWs were observed (two in the paper-based environment and three in the paper-less environment). All the people who were observed were the same people from the pool of six people who were originally interviewed.

5.3.2.2 Structure of observation

Observation of the CHCWs lasted for approximately 30 minutes per visit. Patients who allowed the researcher to enter their homes and observe the CHCW were required to sign consent forms which gave permission for the researcher to be in their homes. The observations were recorded on video. Both the CHCW and the patient had the option to participate in the video or not and to have their faces shown or hidden through digital video manipulation.

5.3.2.3 Data capturing

The observations that were conducted with the CHCWs were recorded on a video camera. Field notes were also made by the researcher during the observations.

5.3.2.4 Limitations and problems experienced

No problems were experienced with the data collection during the observation period.

The process to analyse and interpret the data in order to gain a consolidated list of factors affecting the use of mobile devices for remote data collection in home-community based care is described in sections 5.4 – 5.7. The description is structured according to phases as follows:

Phase 1: Factors from literature
Phase 2: Factors from interviews
Phase 3: Factors from observations
Phase 4: Consolidated list of factors

As explained in Chapter 2, directed content analysis was used to analyse the data. Directed content analysis requires that literature be used as a base for the analysis of the data gathered.

5.4 PHASE ONE: FACTORS FROM LITERATURE

In phase one the factors that are taken from literature were identified. Literature pertaining to the challenges faced by CHCWs in the home community based care environment while they conduct their data collection duties was examined. The first step was to search for literature that discussed any challenges CHCWs face in the HCBC using paper-based methods. The second step was to search for literature that discussed any challenges CHCWs face in the HCBC environment when using mobile technology (paper-less methods). The relevant literature was read and themes representing factors which could affect the CHCWs during data collection, identified. Literature on the challenges they encounter in the environment while using paper-based methods was discussed in Chapter 3, section 3.5.2. The challenges that they face with using paper-less methods were discussed in Chapter 4, sections 4.4.1 and 4.4.2.

Once the literature codes were finalised, the interview data had to be analysed. The process of determining the factors from the interview data is discussed in the following section.

5.5 PHASE TWO: FACTORS FROM INTERVIEWS

Phase two deals with the identification of factors from interviews. The following process was followed to analyse the interview data and identify these factors:

When analysing the interview data using the directed content analysis process the researcher first started by reading each interview transcription from the beginning to the end like a novel. Then the transcripts were carefully read again to highlight text that could be factors impacting CHCWs during the collection of data and a keyword or code was assigned to this. The preliminary codes were taken from the list of factors identified from literature in phase one and these were assigned to the highlighted text. If highlighted text did not fit into the already defined codes, a new code was assigned to it. This was done exactly the same for the first four transcripts for Interviewees A – D. For the last two transcripts for interviewees E and F, factors that had already been identified in the first four transcripts were ignored. In these transcripts only new possible factors were coded. All the coding was performed using Microsoft Excel 2010. Once the coding process was done and the researcher was satisfied that all the factors had been identified, the codes were examined and an attempt was made to group similar codes that were found in the interviews into one code to ensure that there were no discrepancies or redundancies.

The factors identified from literature were also used as the base for coding the themes identified from the observations. The process of identifying the observation factors is discussed in the following section.

5.6 PHASE THREE: FACTORS FROM OBSERVATIONS

For the observations, the field and additional notes were analysed to identify any factors that could be seen as affecting CHCWs during data collection. During the observations, field notes were made and a recording of the observation was made. The video recording of the observation was watched and additional notes were made to supplement the field notes. A directed content analysis process was applied on the field and additional notes of the observation data. The field and additional notes were read carefully and text that could be seen as factors impacting the CHCW during data collection were highlighted and a code assigned to it according to the codes identified in phase one. If highlighted text could not fit into a predefined code, a new code was assigned to it. Once the coding process was done the codes were examined and grouping of similar codes was attempted to ensure that there were no discrepancies or redundancies.

5.7 PHASE FOUR: FACTORS AFFECTING THE USE OF MOBILE DEVICES FOR REMOTE DATA COLLECTION IN HOME-COMMUNITY BASED CARE

In phase four the factors that were identified through literature, interviews and observations were consolidated and categorised into either being social, environmental or technical factors. The consolidation of factors from literature, interviews and observations results in one set of socio-technical factors.

Table 5.1 maps the factors to the data collection methods that were used to identify the factor. This is useful in showing which methods were used to identify each factor.

Factor name	Literature	Interview	Observation
Social factors			
Age		X	

Factor name	Literature	Interview	Observation
Care giving experience		X	X
Emotional stress	X	X	X
Language barriers	X	X	X
Lack of commitment	X		
Lack of education and illiteracy	X	X	
Lack of skills	X	X	
Mobile phone ownership		X	X
Mobile phone training		X	X
Preference of where to capture data		X	X
Remuneration	X	X	
Use of technology blurs the line between work and personal life	X		
Environmental factors			
Crime	X	X	
Dealing with denial, stigma and discrimination	X	X	X
Distance between CHCW and patient		X	X
Lack of devices	X		
Lack of electricity	X		
Lack of funding	X		
Lack of reliable internet connection	X		X
Lack of supplies	X	X	X
Lack of support from government	X		
Lack of trust	X		
Language barriers	X	X	X
Occurrence of data collection		X	X
Poverty	X	X	X
Privacy	X	X	
Road and weather conditions	X	X	X
Stereotypes	X		
Time spent capturing data		X	X

Factor name	Literature	Interview	Observation
Transport issues	X	X	X
Technical factors			
Airtime dependency		X	
Backup issues	X		X
Familiarity of forms			X
Input mode			X
Keypad size			X
Mobile health application only working on certain mobile phone networks using pre-paid accounts only	X		
Mobile health application only runs on certain operating systems	X		
Mobile health application can only run on certain phones	X		X
Mobile phone brand			X
Portability		X	X
Screen brightness			X
Screen size			X

Table 5.1 Mapping of the factors to data collection methods

In section 5.8, the results from the execution of phase four of the analysis and interpretation of the data, are discussed.

5.8 RESULTS AND DISCUSSON

In this section, each of the factors shown in Table 5.1 is discussed, supported by data from the case study and literature. It should be noted that some factors which were not identified as part of the literature review reported as part of phase one, but were identified as part of the case study, are supplemented by literature over and above literature referred to as part of phase one in the following discussion. The

reason why this literature was not reported initially is because it draws from general literature regarding the relevant factor, and not literature from the HCBC context. **For this reason, the "literature" box is not selected with a cross, but marked with a star (*), as the evidence presented here is argued towards the HCBC context.**

5.8.1 Social factors

5.8.1.1 Age

Factor name	Literature	Interview	Observation
Age	*	X	

According to literature, the age of a CHCW does play a role when it comes to performing data collection duties. Ziefle and Bay (2005) conducted a study with two groups of people – the first group aged 20-35 and the second group aged 50-64. They found that the older a person is, the lower their navigation performance. It is therefore concluded that there is some evidence that age is a factor in determining how effectively users can use a mobile device. The CHCWs in the research study's ages ranged from 34 to 63. Although it is acknowledged that this does not constitute a trend, it was interesting to find that in the Emmanuel Haven case study, the oldest person, aged 63, was the fastest user.

5.8.1.2 Caregiving experience

Factor name	Literature	Interview	Observation
Caregiving experience		X	X

All the CHCWs interviewed have had experience in care giving through caring for sick family members such as their parents, grand-parents, aunts, uncles and even in-laws. Interviewee C stated that she had been caring for sick family members from an age as young as 12.

> *"My grandmother was a sister and she used to help people give birth. I gained experienced because I used to help her a lot… At the age of 12 years that's*

where I got the experience because my grandfather was a teacher and a pastor and he got sick and I was the one who looked after him. I looked after my whole family. My mother, father, they passed away. My in-laws as well. So I began to love this thing of looking after people."

The more experience a CHCW has, the easier it is for them to understand the mobile health application's data capturing requirements from a content point of view. Experienced caregivers will find it easier to understand the health terms used in the application.

5.8.1.3 Emotional stress

Factor name	Literature	Interview	Observation
Emotional stress	X	X	X

The work that the CHCWs perform on a daily basis taking care of patients is stressful. When they have to perform data collection duties, this stress can have an effect on them and their concentration levels. The interviewees reported that working with patients that were sick and living in poverty affected them emotionally as they were unable to provide them with financial means since they were also in financial need and their stipends could barely support their own families. One interviewee stated that:

"Andikwazi nolala ebusuku" (sometimes I find it hard to sleep at night).

Due to the fact that they were thinking about patients' conditions, they couldn't wait for the next morning so that they could go and check on the patient. The stress experienced by the CHCW could potentially have an effect on their data collection duties as they might make small mistakes due to the fact that they are emotionally stressed and their concentration levels are lacking. This will be exacerbated in a period of adaption when a new technology such as a mobile phone is introduced to be used for data capturing.

5.8.1.4 Language barriers

Factor name	Literature	Interview	Observation
Language barriers	X	X	X

Language can be a barrier to the adoption of technology according to Beekhuyzen, von Hellens and Siedle (2005) as users can sometimes be reluctant to use a technology if it is not in their native language. The home language of all the interviewees was isiXhosa but the paper-based forms that they used were all in English. Due to this, the CHCWs did need to have a high level of understanding of the English language to be able to collect the data using paper-based forms in English. The mobile application was also developed in the English language and again, a high level of understanding of the English language was required. However, because the mobile phone forms were an exact mapping of the paper-based forms used at the haven, the caregivers did not show any lack of understanding of the English prompts.

5.8.1.5 Lack of commitment

Factor name	Literature	Interview	Observation
Lack of commitment	X	X	X

A certain level of commitment is required from the CHCWs so that they stay motivated to use the mobile phone to collect data. Interviewees E and F started being volunteer CHCWs in 2001 and 2003 respectively which equates to 10 and 8 years respectively. The rest started in 2008 which equates to 3 years of being a volunteer CHCW. The experience of caring for family members from a young age was a major motivation for the interviewees in becoming CHCWs. This experience of taking care of someone has built their passion for wanting to become caregivers for their community and loving the job that they do. Interviewee E stated that one is born with the passion of wanting to take care of the sick as you have too much empathy to not want to help a sick person.

The number of years that the CHCWs have been at the Emmanuel Haven and the fact that they are doing this job because of the passion they have for care giving shows that they are committed to the work. However, they also need to remain committed to using a mobile phone to collect their data. When asked about the possible use of mobile phones for data collection, interviewee C shouted “Please!” because she felt that the use of mobile phones over paper-based forms would be much easier for them.

A lack of commitment to the continued use of the mobile phone for data capturing was not encountered in the case study because it was a pilot study in which the mobile phones were used for data capturing at the haven only for the duration of the data gathering done for the research. It should be mentioned that there was a clear overstatement of expectation in some cases, for example interviewee C stated:

> *“I don’t see anything that would make using the phone difficult. Would there be? It would be a phone for work not for private use? Therefore I wouldn’t say I don’t have airtime. I won’t say I didn’t visit a certain patient because I didn’t know how to do something on it. The phone would be made in such a way that it would always be working all the time.”*

The conclusion can therefore be reached that lack of commitment to the continued use of mobile phones for data collection, requires further evidence based on an environment where caregivers are providing feedback on existing use of this technology.

5.8.1.6 Lack of education and illiteracy

Factor name	Literature	Interview	Observation
Lack of education and illiteracy	X	X	

The highest level that the CHCWs who were interviewed had passed was Grade 11 – this was the case for five of the six CHCWs but one of them was currently in the process of writing her exams to complete her Grade 12 (Matric). One had only

passed Grade 10. A CHCW's educational level has an effect on his or her data collection duties because the lower the education, the lower the ability to read and write efficiently. This will in turn have an impact on their data collection abilities.

5.8.1.7 Lack of skills

Factor name	Literature	Interview	Observation
Lack of skills	X	X	

A certain level of mobile phone skills is required for the CHCW to be able to carry out their duties of capturing data from patients. This factor is interlinked with the mobile phone ownership factor and therefore will be discussed in detail hereafter.

5.8.1.8 Mobile phone ownership

Factor name	Literature	Interview	Observation
Mobile phone ownership		X	X

All of the CHCWs owned a mobile phone. Three out of six of these mobile phones were basic, cheap cell phones which had limited capabilities. The CHCWs' mobile device usage as an expression of average use of functions in any one week was measured and recorded as follows.

	Never	Seldom 1 x p/w or less	Sometimes 2-3 x p/w or less	Most times Once a day or less	Always Every day, multiple times
SMS		2	3		1
MMS	6				
Internet access	5		1		
Make Calls		1	1	1	3

Play games	4	1	1		
Instant messaging	5		1		
Take pictures	3	1		1	1
Take videos	4			1	1
Listen to music	2	1		1	2
As an organiser (calendar, notes, to do list, calculator)			3	1	2

x p/w = times per week

Table 5.2 Mobile phone usage evaluation

Table 5.2 shows the interviewees' usage of the cell phone capabilities. Sending smses, making calls and using the organisational tools such as calendar and calculator were the most used functions on the mobile phone according to the interviewees. The usage of the sms and calling capability was mostly airtime dependent and since the interviewees are volunteers who rely on a stipend, airtime is a scarce resource. Using the mobile phone to listen to music was reported by four of the six CHCWs. Taking pictures with the mobile phone was used by three of the six CHCWs. Taking pictures, videos and listening to music was only used if the phone was capable of it which was the case for three of the six mobile phones.

CHCWs who own mobile phones find using the phones for data collection to be easier as they already understand it. Those who have never used one experience some difficulties. It is acknowledged though that while the CHCWs' utility of their phones will contribute to their understanding of using it for data capturing, there are other factors such as training, which will also play a role.

5.8.1.9 Mobile phone training

Factor name	Literature	Interview	Observation
Mobile phone training		X	X

Just like all the interviewees have received some sort of training which has aided them to gain information related to caring for patients with various diseases, provide counselling and nutrition information to patients, training would also be needed for them to be able to efficiently use the mobile phone for data collection. These sentiments were re-iterated by the CHCWs when asked if they would prefer to use the mobile phone for data collection when they responded:

"If I was taught yes I would be comfortable."

"Yes because we would have been taught how to use the phones properly."

After the mobile health application was created using Episurveyor, the CHCWs were sufficiently trained before they were observed using the mobile phones. A lack of mobile phone training can result in the mobile phones not being used as effectively as they could be for data collection and this will have an effect on the data collected.

5.8.1.10 Preference of where to capture data

Factor name	Literature	Interview	Observation
Preference of where to capture data		X	X

Four of the six CHCWs interviewed stated that when they were visiting patients at home they did not carry the forms, instead they carried a notebook in which they recorded everything that they did in the patient's home. When they got to their homes, they would then fill in the forms based on what they had written in their notebooks.

"You have a diary and the patient's forms but it is embarrassing to have to write everything in front of a patient. You have to have this diary that you write all the information in and when you get home you just transfer from the diary to the forms."

The other two interviewees preferred capturing the patient data during the visit.

"You do not go home to write the information because the patient is not in front of you anymore. You might end up mixing up the information. I look after 8 people and I might end up forgetting which one had which disease."

"You have to write down everything while you are with the patient so the patient themselves can also see what you have written and they can see that you are not writing something that is wrong."

Each CHCW has a preference of where they like to capture data; be it at the patient's home or at their home. Each of these environments is different and has its own advantages and disadvantages which could have an effect on the data that is collected. If data is collected in the patient's home its quality might be higher because the information is still fresh in the CHCW's mind. Therefore the preference of where to capture data must be considered as a factor that could affect data collection.

5.8.1.11 Remuneration

Factor name	Literature	Interview	Observation
Remuneration	X	X	

All the interviewees are volunteers and the only income they receive is through a stipend. The stipend at the Emmanuel Haven for CHCWs is currently set at R600 per month. During the interviews they reported that the last time they received a stipend was in March 2011, however, they still carried on working as they feel their patients need them and they cannot abandon them.

"The money is an issue but it doesn't affect my work as my work will be done regardless of money issues."

"Wages are currently affecting us now because we last got paid in March. We have been told that the place that is responsible for our wages currently does not have money."
"Just because we are not being paid does not mean that we are not working. We can't say to a patient I'm not coming tomorrow just because we have not been paid, that has nothing to do with the patient."

"I use about 14 rand per day, times by 30 days. In my salary it leaves me with nothing and there isn't even someone at home who works - I am the only one."

It can be concluded that although the CHCWs will continue working even if they are not paid, those that rely on the stipend to cover transport costs, will not be able to continue working if not paid.

5.8.1.12 Use of technology blurs the line between work and personal life

Factor name	Literature	Interview	Observation
Use of technology blurs the line between work and personal life	X		

For someone who has not used technology for data collection purposes, the use of technology can feel like an invasion into their private lives. If the CHCWs have not used mobile phones before they might find the use of this technology invasive to their personal lives. This factor was not experienced in the case study as the use of mobile phones by the CHCWs in Emmanuel Haven was done during a pilot study and the factor of the technology interfering with their work and personal lives could not be measured. This remains a relevant factor which needs to be considered for the final list of factors because if CHCWs feels that they cannot distinguish between their work and personal life due to technology, they might end up not using the technology and data collection would be affected.

5.8.2 Environmental factors

5.8.2.1 Crime

Factor name	Literature	Interview	Observation
Crime	X	X	

All the CHCWs in this research study were females and working in Motherwell, which has been stated to be crime-ridden. As the majority of CHCWs are female, having to use an expensive mobile phone in these environments can be troublesome as CHCWs fear for their lives. None of the CHCWs who were interviewed had been affected by crime. Interviewee B stated that even if there was crime in the area, she would still carry on working as her patients were important to her.

"It hasn't affected me yet. I haven't been affected by it, I still travel safely."

If CHCWs have a fear to carry the mobile phones due to crime, these will end up not being used at all. Therefore crime as an environmental factor needs to be considered.

5.8.2.2 Dealing with denial, stigma and discrimination

Factor name	Literature	Interview	Observation
Dealing with denial, stigma and discrimination	X	X	X

CHCWs sometimes have to deal with discrimination and stigma associated with working with HIV/AIDS patients from their community and even the patients' family members. This makes it difficult for them to be able to gather information, especially if the patients or their family members do not want the CHCW to be seen at their home for fear of being discriminated against.

"For example you find that there is a mother living with her HIV positive daughter. You find that the daughter is now not accepted by the rest of the family that is a big problem we face. You find that they don't even want to go into her room, they make her sleep outside in a shack alone because they say she might pass the disease to them... you find that the daughter is now discriminated against by the family."

"When you go visit a patient, you should not wear uniform because our uniform is known."

"The patients do not want their neighbours to see that Nxiweni's (The founder of the Emmanuel Haven is Dr Nxiweni therefore the CHCW are sometimes referred to as Nxiweni's people) people come to their home because they know what the people come to do... If you are out looking for patients, you shouldn't do that wearing uniform otherwise you will not find people. They are scared of stigma.

The denial, stigma and discrimination that the CHCWs face from the patients' families and sometimes the patients themselves can be a hindrance to their data collection duties. If the patients or their families prevent a CHCW from entering their home, no data collection can be done.

5.8.2.3 Distance between CHCW and patient

Factor name	Literature	Interview	Observation
Distance between CHCW and patient		X	X

The distance between the CHCW and patient plays a critical role when it comes to data capturing because if the patient is too far from the CHCW it becomes difficult for the CHCW to be able to effectively capture data as distance is a barrier.

"..Working here in Motherwell I don't use bus fare I just walk to my patient's home."

“I came here knowing that I am a volunteer and I won’t have enough money to use for transport so I had to choose a place to work that was close.”

The CHCWs all work in the environment that they live in and this was due to the fact that they were volunteers and did not have money to use on taxis or buses. It is easier for them to walk to the care haven and to the patients if they live in the same community as the patient. The closer the CHCW is to the patient, the easier it is to visit a patient and collect patient data.

5.8.2.4 Lack of devices

Factor name	Literature	Interview	Observation
Lack of devices	X		

Each CHCW needs to have her own mobile phone to ensure the use of the mobile phone for data capturing becomes a part of her daily life. A lack of devices was not experienced in this study as the use of the mobile phones was only for a trial period for purposes of the research and therefore this factor could not be experienced. It is a relevant factor to consider for other contexts where a lack of devices could be relevant.

5.8.2.5 Lack of electricity

Factor name	Literature	Interview	Observation
Lack of electricity	X	X	X

Motherwell is a well serviced area with running water in most houses, proper sewerage systems and prepaid electricity. Electricity is required in order to charge the mobile phone that will be used for data collection. Even though the lack of electricity was not experienced in this case study, it needs to be considered for other contexts. In order for the mobile phone to be functional, it needs to be charged. In some developing countries electricity is a scarce resource (Chetley, 2006). Therefore

the lack of electricity needs to be considered as an environmental factor relevant to the use of mobile phones for data collection.

5.8.2.6 Lack of funding

Factor name	Literature	Interview	Observation
Lack of funding	X	X	

Funds are required in order for any project to be successful. A lack of funding can cause various problems, for example a lack of funding could result in there not being enough mobile phones which will prove problematic as some CHCWs will not be able to perform their duties. In this case study, a lack of funding resulted in the CHCWs not being paid their stipends.

> *"We do get paid when there is funds available but for now we haven't been paid. "*

> *"We have been told that the place that is funding our wages currently does not have money."*

Various stakeholders such as the government, donors, funders and telecommunication operators all have a role to play to ensure that mobile health is implemented successfully in any country that undertakes to implement it (Mechael et al., 2010). Proper financing structures need to be in place to ensure that mobile health is implemented correctly and successfully in developing countries.

5.8.2.7 Lack of reliable internet connection

Factor name	Literature	Interview	Observation
Lack of reliable internet connection	X		X

Developing countries generally suffer from a lack of reliable and proper infrastructure to provide reliable internet connection which can make the uploading of information

troublesome. A reliable internet connection is required when uploading information from the mobile phone to the servers. A lack of reliable internet connectivity can have an effect on the CHCWs' data collection duties (Chetley, 2006). The lack of a reliable internet connection was experienced in the case study when it took a long time for information collected to be uploaded to the server. This factor is a factor which needs to be considered in contexts where there is a lack of a reliable internet connection.

5.8.2.8 Lack of supplies

Factor name	Literature	Interview	Observation
Lack of supplies	X	X	X

A lack of supplies can be a hindrance to the CHCWs doing their work.

> *"I just wish we always had enough supplies in our kits when we visited their houses."*

> *"I just wish that there could be everything that we need in our kits."*

> *"What we struggle the most is our kits. We do have kits but they don't always have the supplies we need..."*

The lack of supplies can affect the CHCWs data collection duties because some data might not be collected due to the fact that the CHCW could not perform certain duties.

5.8.2.9 Lack of support from government

Factor name	Literature	Interview	Observation
Lack of support from government	X		

Support from the government is required to ensure the sustainability of the mobile health initiative. A lack of support from government was not experienced in this case study but it is considered an important factor to HCBC environments in general. A lack of support from government remains a relevant factor because given the government's formal acknowledgement of the role of HCBC programmes in South Africa (as per the Community Health Care Worker Policy Framework discussed in section 3.6.4) their support is needed to ensure that HCBC programmes remain sustainable. Improved data capturing systems will, in turn, provide improved input (data) to government information systems.

5.8.2.10 Lack of trust

Factor name	Literature	Interview	Observation
Lack of trust	X		

A certain level of trust is required from the patients in order for them to be able to trust the CHCW enough to provide them with information. If the patient does not trust the CHCW, no information can be collected. Tapia and Maitland state that even though ICTs can break down barriers, it can create fear as patients find it easier to trust paper-based systems than to trust technology (2009). A lack of trust needs to be considered as a factor to data collection because without the patient's consent and ability to trust technology, data collection might not occur.

5.8.2.11 Occurrence of data collection

Factor name	Literature	Interview	Observation
Occurrence of data collection		X	X

Apart from performing duties related to caring for the patient's health, CHCWs have to ensure that the environment the patient is living in is clean. Table 5.3

demonstrates a scenario that shows the kind of care CHCWs have to perform at a patient's home. This was related by CHCW C during the interview to explain her daily activities.

Scenario:

CHCW enters patient house and detects an odour

CHCW: Gogo, mani ingathi ilanga lishushu?! (Gogo, it looks quite hot outside doesn't it?!)

proceeds to open windows

CHCW: Gogo, amathambo, iArthritis ivukile neh? (Gogo, how is the arthritis?)

Patient: oh mntanam, kange ndilale. (My child, I did not sleep)

CHCW: Gogo mandiqale nje ngotshayela... uphi umtshayelo?! (Gogo, let me start by sweeping the house, where is the broom?)

Proceeds to sweep the house. *If there is any disinfectant uses that to scrub the floors and bathroom, airs the beds, washes dishes.*

CHCW: Gogo, uke watya? (Gogo, have you had anything to eat)

Patient: oh mntanam, kange nditye. Nalombani umncinci. (My child, I have not eaten. This electricity is also about to run out).

Proceeds to look in the cupboards for food. Finds mealie meal and cooks that. Dishes up for patient and feeds her. Also dishes up for herself to show that she is not disgusted by the patient. After eating, washes dishes, soaks the dish cloths.

CHCW: Gogo, wethu ndizobeka amanzi nje ukuthi uvase nawe. Ndizakunceda, ungabi nangxaki wena gogo. (Gogo, let me heat up some water so that you can take a bath. I will help so you don't have to worry yourself about it gogo).

Proceeds to wash the patient and dresses the patient.

Table 5.3 Community health care worker caring for a patient

This account from the caregiver, showing that the tasks of the caregiver extend beyond basic nursing provides insight into the multi-dimensional role they fulfill. The duties that the CHCW has to perform in a patient's home determine when they will be able to collect patient data. Therefore, the duties that a CHCW has to perform

must be considered and related to how this could have an effect on their data collection duties.

5.8.2.12 Poverty

Factor name	Literature	Interview	Observation
Poverty	X	X	X

The interviewees reported that seeing their patients living in poverty without adequate food worried them as this meant that they would not be able to take their medication. Interviewee C and F stated that sometimes they would end up providing for the patients through using their own stipend money.

> *"You become worried when you get to a patient's home and they have no food. "*

> *"Sometimes you get a patient and they say they haven't taken their medication because they do not have food to eat and they can't take their medication on an empty stomach. If you are capable you can bring them food."*

> *"It affects me a lot. I'm a very emotional person who cries easily..."*

5.8.2.13 Privacy

Factor name	Literature	Interview	Observation
Privacy	X	X	

Privacy concerns arise if there is a shortage of devices as patients feel that any CHCW can view their information. The CHCWs felt that in terms of data collection the information that they collect is very private and should not be easily viewed by anyone. They sometimes take this information they collect back home and they feel a need for it to be protected even from their own families as they collect private

information such as people's HIV status and this information is considered confidential.

> *"Everything is kept safe" (referring to the use of a mobile phone)*

> *"Even in the house your phone must not be a play thing because it contains very private and important patient information. It is between you and the centre only. So nobody not even your husband must touch your phone."*

Through the use of mobile phones the privacy around a patient's information could potentially be improved as all the information is stored electronically and could be protected through the use of passwords. Access to the information could be restricted to only authorised personnel.

5.8.2.14 Road and weather conditions

Factor name	Literature	Interview	Observation
Road and weather conditions	X	X	X

The Motherwell community has poor roads as illustrated in figure 5.1 and the road conditions deteriorate even more during rainy days as they become slippery when wet. Some care workers stated that they do not even go to work if it is raining and this means that patients receive fewer visits in that certain week. The interviewees complained that their shoes get torn and old quickly as the roads are not tarred.

Figure 5.1 Poor road conditions of Motherwell Township.

"The poor road conditions do affect me especially when it rains because the roads become muddy."

"Even if it is raining we have to go visit our patients because at the end of the month we will not have any report to submit."

"Yes the roads I use have lots of rocks and there is no tar, it's like a farm, It even damages our shoes"

Poor road conditions and weather conditions can prevent a CHCW from being able to visit a patient which prevents them from collecting data. Weather conditions are an influencing factor for the CHCW. When it rains some CHCWs find it difficult to visit their patients as they are not willing to venture out into bad weather.

5.8.2.15 Stereotypes

Factor name	Literature	Interview	Observation
Stereotypes	X	X	

In developing countries there are stereotypes that are gender-based. In these countries CHCWs are predominantly female and this was shown to be true in our

case study because all of the interviewees that were interviewed were females. Due to the fact that stereotyping might cause prejudice, this factor is relevant and needs further investigation of its possible effect on the CHCW and their data collection duties.

5.8.2.16 Time spent capturing data

Factor name	Literature	Interview	Observation
Time spent capturing data		X	X

The duties that the CHCW have to perform determine how much time they will have to capture data. All the respondents indicated that they spend between 10-15 minutes capturing data for each patient either at the patient's home or at their homes.

5.8.2.17 Transport issues

Factor name	Literature	Interview	Observation
Transport issues	X	X	X

All of the CHCWs had to walk to their patients' homes as taking public transport such as buses or taxis would waste their already limited stipend.

> *"I do not have money for transport and I will have to walk."*

> *"It rains and the distance from NU2 to NU3 is far and I have to use transport but the problem is that it's decreasing my money I use to travel to work because it cost R6.50."*

In some rural areas in developing countries, transportation is an issue. This makes it difficult for the CHCW to regularly visit such areas to take care of their patients and collect information. In the case study this was not experienced due to the proximity of

the caregivers to their patients. The only problem that CHCWs faced was the money required to use the transportation when required.

5.8.3 Technical factors

5.8.3.1 Airtime dependency

Factor name	Literature	Interview	Observation
Airtime dependency	*	X	

Data transfer costs are determined by how your data is transported i.e. SMS or GPRS. For example in South Africa, an SMS costs 80cents while 1MB of data costs R1 (MTN, 2008). High mobile service charges can limit the usage of mobile health solutions (Norris, Stockdale & Sharma, 2009). Therefore these costs need to be carefully considered to ensure that the use of m-health solutions does not end up being too costly to the user resulting in them not using the solution.

> *"It would be a phone for work not for private use? Therefore I wouldn't say I don't have airtime."*

One of the interviewees assumed that since the phone would be for work that it would always have airtime which they could use during data collection. A certain amount of airtime is required in order to ensure that data can be uploaded onto the central server. The dependency on airtime needs to be considered in the use of mobile phones for data collection.

5.8.3.2 Backup issues

Factor name	Literature	Interview	Observation
Backup issues	X		X

Since internet connections are not reliable in developing countries the mobile phone needs to be able to allow for the data that has been collected by the CHCWs to be

backed up offline and uploaded later when the internet connection is available. The backing up of information seemed to be a key advantage as some CHCWs believed that by using a mobile phone to store captured data they would be able to access old patient records and see what diseases a patient has suffered from before to ensure that what a patient says to them does not contradict with what is actually in the patient's record. This expectation of the use of mobile phones can only be fully realized if internet connectivity is improved upon.

This was experienced during the case study. During the observation it would sometimes take a long time to connect and upload the data and if there was an ability to back up the information and upload it later, this would have been more convenient. Backup issues are considered a factor to the collection of data by the CHCWs.

5.8.3.3 Familiarity of forms

Factor name	Literature	Interview	Observation
Familiarity of forms			X

Table 5.4 shows the types of paper-based forms that community health care workers in the Emmanuel Haven use.

When a community health care worker visits a patient for the first time, they have to fill in a household registration form. This forms contains details such as: particulars of the head of the household, particulars of the other household members, evaluates the home environment with regard to whether it is a formal or informal house, whether there is running water, electricity and proper sanitation.
The second form that they need to fill in is the patient categorization assessment form. This form is used to assess the patient to see how often they would need to receive a home visit. These two forms are only used once when the patient is visited for the first time.

On a patient's daily visit the patient record form is used. The patient record form is the one that is used the most as this is the one that the care worker uses to detail the kind of care that was provided to a particular patient and it is required that this form be signed by a family member when the care worker leaves to show that they were actually present at the patient's home.

Table 5.4 Paper-based forms used

When the mobile health application was created with Episurveyor, the questions from the paper-based forms were taken as is therefore there was some familiarity between the paper-based systems and the mobile phone. This advantage experienced during the Emmanuel Haven case study could be a limiting factor if the mobile health application is not designed around the familiarity of paper-based data collection forms.

5.8.3.4 Input mode

Factor name	Literature	Interview	Observation
Input mode	*		X

The way that information such as numbers is entered during data collection by the CHCW could have an effect on the time they take to collect patient data, the quality of the data and the number of errors. Africa is traditionally an oral culture and the reading culture is still on the rise (Bukachi & Pakenham-Walsh, 2007). Due to this oral-orientated systems are more accepted in these cultures than text-based systems (Sharmer-Grover, 2009). The error rates of inputting data via sms, forms and voice were evaluated by Patnaik, Brunskill and Thies (2009) and they found that the use of voice-based inputting modes resulted in fewer errors than the use of sms or forms. Even though voice data entry results in lower errors, it is more costly than either sms or forms based data entry. Forms based data entry is preferred as it is the cheapest and not data restricting.

5.8.3.5 Keypad size

Factor name	Literature	Interview	Observation
Keypad size	*		X

The size of the key pad numbers is identified as a factor as the keypad size affects the way that the CHCWs used the mobile phone for data capturing. The small keypad size factor of the mobile phone can be a constraint to the uptake and usage of mobile health as these are viewed as constricting usability of the device (Norris, Stockdale & Sharma, 2009). In this research study, one of the CHCWs had to use her nails as she felt that the keypad size was too small. Therefore the size of the keypad of the mobile phone needs to be considered to ensure that it is usable by the CHCW.

5.8.3.6 Mobile health application only working on certain mobile phone networks using prepaid accounts only

Factor name	Literature	Interview	Observation
Mobile health application only working on certain mobile phone networks using prepaid accounts only	X		

The mobile health application must be considerate of all the networks types to ensure that no matter what type of mobile phone is used by the CHCW they will still be able to collect patient data. This factor was not experienced in the case study because the application which was created with Episurveyor was compatible with the services that the mobile phone networks in South Africa provide. This factor needs to be considered in the list of factors because some mobile phone networks might not support a mobile health application and this will be problematic in terms of data collection especially when having to upload the data to the server.

5.8.3.7 Mobile health application only runs on certain operating systems

Factor name	Literature	Interview	Observation
Mobile health application only runs on certain operating systems	X		

The type of operating system on a mobile phone should not hamper the mobile health application. The mobile health application must consider the range of operating systems that it needs to cater for. The restriction due to a mobile health application only running on certain mobile phone operating systems was not experienced in this case study as the mobile health application created was compatible with the operating system of the phone that was used. This factor is relevant and needs to be considered in the list of factors because it should be noted that whatever mobile health application is developed, it should be compatible with the various operating systems envisaged to be used.

5.8.3.8 Mobile health application can only run on certain phones

Factor name	Literature	Interview	Observation
Mobile health application can only run on certain phones	X		X

The application used to collect patient data should be considerate of the range of phones that are currently available to ensure that whatever phone is used by the CHCW can be used for data collection purposes. This factor was experienced in the case study as it was difficult to find an Episurveyor version that was compatible with the Nokia 5130 express music phone that was used.

5.8.3.9 Mobile phone brand

Factor name	Literature	Interview	Observation
Mobile phone brand	*		X

CHCWs who own mobiles phones find using the phones for data collection to be easier as they already understand it; those who have never used one experience some difficulties (Skinner, Rivette & Bloomberg, 2007). The same applies to the mobile phone brand. A CHCW who uses a Nokia phone might find it difficult to adjust to using a different mobile phone brand. The brand of mobile phone a CHCW uses plays a role because using a different brand of mobile phone for data collection from the one they are used to can require some additional time for adjusting.

5.8.3.10 Portability

Factor name	Literature	Interview	Observation
Portability		X	X

Since the CHCWs work in environments where they have to walk from one house to another, they need to use a device that is easy to carry. CHCWs in developing countries work alone in remote areas and the use of a mobile device provides access to information to these CHCWs in remote areas. The fact that the mobile phone is portable means that it can easily be carried by the CHCW and it can provide them a means to remotely capture data without the use of paper-based forms. Portability is considered a technical factor because an ICT solution that is to be used by CHCWs in HCBC requires that the ICT solution be lightweight enough for them to carry it for a full working day without feeling that it is heavy.

5.8.3.11 Screen brightness

Factor name	Literature	Interview	Observation
Screen brightness	*		X

The screen should be bright enough for the CHCW to be able to view what is on the screen because if they cannot see what is on the screen they will be unable to capture the data correctly. However, the brighter the screen is, the faster the battery runs out (Dawson & Fisher, n.d). The screen needs to be bright enough for the

CHCW but still not consume a lot of battery life. The screen brightness is a factor to consider in the use of mobile phones for data collection by CHCWs.

5.8.3.12 Screen size

Factor name	Literature	Interview	Observation
Screen size	*		X

The size of the screen and the size of the text on the screen must be considered when creating a mobile health application especially for people with poor vision. The size of the screen determines the amount of information that can be put on the screen; this can create a problem for users (Acton, 2004). The smaller the screen is, the less information that can be put on it.

5.9 INTERPRETATION OF THE DATA

The factors that have been presented in sections 5.8.1 - 5.8.3 have been identified through literature, interviews, observations or a combination of these methods. As discussed previously in sections 5.4 – 5.6, the factors from literature were identified first and coded. These codes were subsequently used to code the factors identified in interviews and observations. The identified factors can be viewed in four groups: (1) factors only found in literature; (2) factors only found using empirical data collection methods; (3) factors found in literature and through one of the empirical data collection methods; and (4) factors that were found using all three methods.

Clearly factors that were only found in literature were not identified in the interviews or observation. The literature used to identify these factors was drawn from HCBC-based literature. The context of the cases in this literature is a determinant of the factors that were identified. The fact that they were not found in the case study does not invalidate these factors; it merely shows that in this particular case study it was not found but should be considered important and could be found in other case studies in the future. A case in point is the lack of electricity found in other case

studies, which was not experienced in the Motherwell area where this research was conducted.

The discussion of the factors only found using empirical data collection methods was supplemented with general context literature in the discussion in section 5.8 in order to show the relevance of the factors identified in this research, in other contexts.

The research presents all the factors from the four groups mentioned above as a comprehensive set of factors affecting the use of mobile devices for remote data collection in home community based care.

5.10 CONCLUSION

This chapter has discussed the case study results and formulated a final list of socio-technical factors that affect the CHCW while they are collecting patient data using mobile phones. CHCWs of the Emmanuel Haven in Motherwell were selected to be participants of this research. Interviews and observations were conducted with these CHCWs to collect data that could be used to identify social, environmental and technical factors for the use of mobile phones in the home community based care environment.

The dissertation will conclude in the next chapter.

CHAPTER 6: CONCLUSION

6.1 INTRODUCTION

This chapter provides the conclusion to the study. The research aim, questions and objectives are discussed to show how each question was answered, how each objective was met and if the aim of the research was reached. This chapter further discusses the validity of the study, limitations of the research and further research opportunities. This chapter concludes with final remarks.

6.2 SUMMARY OF THE STUDY

The purpose of this research was to identify socio-technical factors that can have an effect on CHCWs while they are using mobile phones to collect patient data. **Chapter 1** provided background to the study along with the research questions and objectives which had to be answered and met by the research. A research process and design for conducting the research was proposed outlining the philosophy, approach, strategy, time horizon and data collection methods that would be used according to the Saunders et al. (2003) research onion. **Chapter 2** focused on the research methodology in detail highlighting that the CHCWs of the Emmanuel Haven were the case study participants, with whom interviews and observations were carried out. The process of how data was collected and analysed was also discussed in this chapter.

The next two chapters – chapters 3 and chapter 4 were the literature review chapters. **Chapter 3** focused on health care in developing countries, home community based care and the CHCW. The various components of what makes a health care system functional and the various models of home community based care were discussed along with the role that the CHCW plays in the HCBC environment. This provided the basis of identifying the problems that CHCWs face in the execution of their daily duties. These problems were categorised into either being

social, environmental or technical according to the socio-technical systems approach. The chapter concluded by providing a profile of south Africa which described its health care systems and showed how CHCWs fit into this system.

The second literature review chapter, **Chapter 4**, was focused on how mobile devices have been used in health care and more specifically in the home community based care environment. The various mobile devices which can be used for data collection in the HCBC environment by CHCWs were identified as: mobile phones, PDAs, smart phones and mobile telemedicine devices. Due to the high number of mobile phone usage in developing countries with reports that there are approximately 67 mobile phone subscriptions per 100 inhabitants in developing countries, the use of mobile phones was seen as an appropriate solution that could be used by CHCWs for data collection purposes. Various projects that have used mobile phones for this purpose were analysed and problems they experienced were categorised into either being social, environmental or technical problems, also according to the socio-technical systems approach.

Chapter 5 discussed the results of the case study. The four phases of data analysis that were followed in this research were described. The process of identifying factors from literature was described in phase one. Phases two and three dealt with the process of identifying factors from the interview and observation data respectively. A directed coding process was used to identify the phase two and three factors and the phase one factors from literature were used as the base literature. The final phase, which is phase four, presented a consolidated list of factors affecting CHCW when using mobile phones to capture data in order to show the sources that informed the identification of each factor. Thereafter, a detailed discussion of each factor was presented, supported by literature and case study data.

The following section discusses the research questions and objectives and how these were answered and met respectively.

6.3 RESEARCH QUESTIONS AND OBJECTIVES

The research questions and objectives that were listed in Chapter 1 are discussed in this section to show how each one was answered and met:

6.3.1 Research question and objective 1

Research question	Research objective
What is the role of HCBC in healthcare provision in developing countries?	*Ascertain the role of HCBC in health care provision in developing countries.*

Table 6.1 Research question and objective 1

A literature review was conducted that was focused on investigating the role that HCBC plays in the health care systems of developing countries. Through this review it was found that developing countries have a lower spending per capita on health care than developed countries. HCBC plays a role in these developing countries by being a cheaper and convenient alternative health care provision method for its people. It was introduced primarily to alleviate the burden placed on the health care systems of countries with rising incidences of HIV/AIDS. In this regard, HCBC plays a critical role in helping developing countries to provide a healthcare service to its population.

6.3.2 Research question and objective 2

Research question	Research objective
What are the current and potential uses of ICTs, specifically mobile devices, in the broader health care and HCBC contexts?	*Establish how ICTs and specifically mobile devices are used in health care, including the HCBC context.*

Table 6.2 Research question and objective 2

The use of mobile devices for health purposes is mobile health. Mobile health has six categories of use which were discussed in chapter 4. For this research remote data collection was the category that the research focused on. Five mobile device technologies were identified as technologies which could be used for data collection:

- Mobile phone
- Personal digital assistants
- Smart phones
- Mobile telemedicine devices

The capabilities and various uses of these mobile devices in developing countries were investigated, where after the mobile phone was identified as appropriate for use in developing countries by CHCWs for data capturing purposes based on its popularity and the fact that it can overcome barriers such as telecommunications infrastructure and lack of electricity which can cause other ICTs to fail. Examples of mobile health projects for data collection in HCBC in the developing country context were examined and their challenges highlighted. This led to an understanding of how ICTs, specifically mobile devices, are used in healthcare, including the HCBC context.

6.3.3 Research question and objective 3

Research question	Research objective
Which factors can be identified that impact the use of mobile devices for remote data collection in the HCBC context?	*Determine the factors that influence the use of mobile devices for remote data collection in the HCBC context.*

Table 6.3 Research question and objective 3

This research objective was met through conducting a literature review, interviews with and observations of CHCWs in a case study environment in order to be able to identify the factors that impact and influence on their use of mobile devices in the

HCBC environment when they are using these devices for remote data capturing. Three sets of factors were identified from the three data collection methods and these were listed and discussed in sections 5.4 to 5.8 of chapter 5.

6.3.4 Primary research question and objective

Research question	Research objective
Which socio-technical factors will impact the use of m-Health in the HCBC context?	*Compile a set of socio-technical factors that impact the use of m-Health in home community based care. These factors aim to promote the use of m-Health through gaining a better understanding of its impact in this environment.*

Table 6.4 Primary research question and objective

After the factors were identified, a socio-technical lens was applied to these factors to categorise them into either being social, environmental and technical. As was discussed in Chapter 1, the adoption of technology into the health care environment has mainly been techno-centric. This means that it was focused on the technology and not how the technology would fit into the environment and be used by the user. For the health care environment and more specifically for the purposes of this research – the HCBC environment – a socio-technical perspective on the adoption of technology is important to promote the use of m-health through gaining a better understanding of its impact in this environment. This perspective not only focuses on the technology (mobile phone) but also on the user (CHCW) and the environment (HCBC environment).

6.4 VALIDITY OF STUDY

In order to ensure that the data collected in this research study was of the highest quality and was interpreted correctly, the seven principles of hermeneutics (Myers,

2008) that were mentioned in chapter 2, section 2.5.5 are now discussed principle by principle to show how each was interpreted:

Principle 1: The fundamental principle of the hermeneutic cycle

This is the most fundamental of the seven principles of hermeneutics and is fundamental to all interpretive work as it is the one principle that the other six are built upon. The circle refers to the constant interaction between the whole and the part which one does in order to gain more understanding. This process of understanding and interpreting moves from an understanding of the parts to the whole, back to an improved understanding of each of the parts.

In this research, the process of understanding and interpreting according to the hermeneutic cycle starts by understanding the "parts" which are the researcher's understanding of the HCBC environment – mainly gained through literature review, interviews and observations; and also each CHCW's understanding which was gained through their experience of being in the environment. The whole is the shared meaning and understanding of both the researcher and the CHCWs which results in the socio-technical factors.

Principle 2: The principle of contextualization

This principle of contextualization aims to show that due to the historical distance between the interpreter (reader) and the author (researcher) there is a difference in their views or understanding. It requires that the subject matter be set in its social and historical context so that the intended audience can see how the current situation under investigation emerged.

This principle was applied in the beginning of chapter 5 with a discussion that described the Emmanuel Haven case study before the research results were divulged to give a perspective on the type of environment in which the information was collected. The brief background of the case study was discussed in chapter 5, section 5.2.

Principle 3: The principle of interaction between the researcher(s) and the subjects

This principle requires that the researchers place themselves and the subjects into a historical perspective. The social interaction between the researchers and the participants produces the “data” or facts that are regarded as the research data.

This principle was applied by firstly discussing the research methodology in chapter 2, including the research methods that were used for data collection and analysis. The case study results in chapter 5 further describe the details about the interaction between the researcher and the participants and it shows the data that was collected from the participants. During the field visit the researcher had the role of observer so that they could observe the activities that the participants carried out. The researcher and participants each have their different roles but these roles have interacted to produce results which have been used to compile the list of socio-technical factors.

Principle 4: The principle of abstraction and generalization

Abstraction and generalization need to be carefully related to the field study details as they were experienced or collected by researchers so that readers can follow and understand how the researchers arrived at their insights. This principle attempts to relate data that was described in the principle of contextualization to abstract categories while unique instances can be related to concepts that apply to multiple situations.

From the data that was gathered from the case study, social, environmental and technical factors have been abstracted. Due to the fact that the factors were gathered from literature review and only one case study environment, in order for the factors to be generalizable further studies would need to be conducted.

Principle 5: The principle of dialogical reasoning

This principle of dialogical reasoning requires the researchers to confront their preconceptions with data that has emerged through the research process. Hermeneutics suggests that prior knowledge plays an important part in our understanding (Myers, 2008). This principle requires that there be cycles of revision

between our prior knowledge and actual findings to minimize any possible contradictions.

In this research, the researcher's preconception is regarded as the literature review in chapter 2 to 4 and this is confronted with the data that has emerged from the research which is presented in chapter 5.

Principle 6: The principle of multiple interpretations

The researcher is required to examine the influences that are experienced by the participants so that they have the ability to document their multiple viewpoints and reasons. Unlike in the principle of dialogical reasoning where the researcher's conceptions and data were confronted, in this principle the conflicting interpretations of the participants are confronted.

Sensitivity was required when interpreting the multiple meanings of the CHCW interview and observation results to ensure that all the gathered data collaborated to providing something meaningful to contribute to the final outcomes of the socio-technical factors.

Principle 7: The principle of suspicion

The principle of suspicion is concerned with the discovery of false preconceptions and requires the researcher to adopt a critical perspective and not take the participants' views at face value as these could be false preconceptions. The researcher is required to not show any biases to the information collected from the participants.

Bias in this research was avoided through the interviewing and observing of more than one participant and in the use of multiple research data collection analysis methods. This ensured that the data collected would not be distorted in anyway.

6.5 PROBLEMS AND LIMITATIONS OF STUDY

The initial aim of the study was to have two case studies – one case study with a group of CHCWs who were using mobile devices for data collection and one case study with a group of CHCWs who were not using mobile devices for data collection. Due to the fact that the researcher was unable to find a group of CHCW who were using mobile devices, only one case study was used and a mobile health application had to be developed and used by these CHCWs. The CHCWs were trained and they used the mobile health application and data was collected accordingly. Due to time limitations, the CHCWs were only trained for one week and had to use the mobile phones immediately after that for data collection purposes. This impacted on them negatively as they felt that the time was insufficient and they had not fully grasped the use of the mobile phone.

Secondly, the results of this study are limited to having gained a better understanding of the factors affecting CHCWs using mobile phones to capture data, in one case study environment only. While this was sufficient to attain the objectives of this research, further research would be required for generalization beyond this case study.

Lastly, a number of factors which had been identified from literature could not be experienced in the case study because of the pilot nature of the use of mobile phones to capture data. For example, commitment to continued use of mobile phones was identified from literature, but could not be measured in the case study.

6.6 FUTURE RESEARCH OPPORTUNITIES

Understanding the factors that affect CHCWs when they are using mobile phones for data collection in the HCBC environment is important especially when it comes to developing the mobile health applications. These factors do not only deal with technological elements such as the size of the screen or the size of the keypad. These factors also deal with social elements which are brought upon by the CHCWs such as their age and literacy levels and environmental elements such as crime. The

findings of the study have contributed to the existing knowledge of the use of ICTs and more specifically the use of mobile phones in the HCBC environment. The main contribution has been in the area of understanding the factors that affect mobile phone use in this environment.

The research was only conducted in one case study environment and in this environment the mobile device was not used previously; it was only used after the researcher developed a mobile health application which could be used by the CHCWs and only for the period of the research. Due to this the results of the research could not be generalized to other HCBC environments and therefore there is an opportunity for a similar research to be conducted in an actual environment where mobile devices are being used by CHCWs in the HCBC environment as more factors could potentially be discovered. It would also be beneficial if the time horizon of the study could be longitudinal to enable measuring of factors that are influenced over time, such as continued motivation to use mobile phones as a data capturing device.

6.7 CONCLUSION

The importance of adopting a socio-technical perspective for the use of mobile phones in the HCBC environment for CHCWs is indisputable. This study has been successful in identifying the social, environmental and technical factors which can affect the CHCWs when they are collecting patient data in the HCBC environment. It can be concluded that the primary objective of the research, which was to to compile a set of socio-technical factors that impact the use of m-Health in home community based care, has been achieved.

The understanding gained of the social relations and work practices in HCBC, including the use of paper-based record-keeping, provided discerning insights into the challenges CHCWs face in their daily lives. As custodians of the wellbeing of their communities, their perseverance and dedication despite a lack of resources and proper support are astounding. The CHCWs are ideally placed in their communities to serve as catalysts for improved wellbeing. However, their work must be supported

and integrated to realize the potential of an expanded and improved healthcare service. It is hoped that this research will assist to inform the design of appropriate mobile health applications to both ease the burden of CHCWs (i.e. it should be faster and easier to use than paper) and improve the healthcare service provided through enabling access to patient records to all partners in the care continuum.

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APPENDIX A: INTEVRVIEW QUESTIONS

SOCIAL ASPECTS

BUILD PROFILE OF COMMUNITY HEALTH CARE WORKER

1. Note down the participant's gender.
2. What is your home language?
3. What is the language of communication that you use in your daily work, for both (a) data collection and data entry and (b) to communicate with members of the community whom you serve?
4. What is your age?
5. What is your highest education level?
6. Did you have any care giving experience before working in this field?
7. How many years in total have you been a community health care worker?
8. Why do you do this kind of work?
9. What kind of training did you receive in order to be able to do this kind of job?
10. Do you live in the community that you work in?
11. If no, why do you work in a different environment than the one you live in?
12. If yes, why do you work in the same environment that you live in?

KNOWLEDGE OF COMPUTERS AND MOBILE DEVICES

13. Are you computer literate?
14. Rate computer usage as an expression of average use of applications in any one week:

	Never	Seldom 1 x p/w or less	Sometimes 2-3 x p/w or less	Most times Once a day or less	Always Every day, multiple times
Word processor application	1	2	3	4	5
Spreadsheet application	1	2	3	4	5
Internet	1	2	3	4	5
Email	1	2	3	4	5
Social networking sites (e.g. Facebook, Twitter, etc).	1	2	3	4	5
Final Rating (Total out of 25)					

x p/w = times per week

15. Where are your primary and secondary points of access to a computer?
16. Do you own a mobile device? If not, do you access and use a mobile device by alternative means? Indicate your source of access.
17. Rate mobile device usage as an expression of average use of functions in any one week:

	Never	Seldom 1 x p/w or less	Sometimes 2-3 x p/w or less	Most times Once a day or less	Always Every day, multiple times
SMS	1	2	3	4	5
MMS	1	2	3	4	5
Internet access	1	2	3	4	5
Make Calls	1	2	3	4	5
Play games	1	2	3	4	5
Instant messaging	1	2	3	4	5
Take pictures	1	2	3	4	5
Take videos	1	2	3	4	5
Listen to music	1	2	3	4	5
As an organiser (calendar, notes, to do list, calculator)	1	2	3	4	5
Final Rating (Total out of 50)					

x p/w = times per week

ENVIRONMENTAL ASPECTS

EXPLANATION OF DAILY ACTIVITIES

18. How many patients do you care for, on average, per day? Discuss the exceptions.
19. How long does your working day last? State the starting and end times on average and exceptional days.
20. Roughly how much time do you spend with each community member?
21. Explain your course of action from the moment you walk into a community member's house up to the moment that you leave?
22. What is the nature of the data that you have to gather on a working day?
23. How much time do you spend while in the community, capturing this data?
24. How much time do you spend, in addition to point 21, to capture the data and where is this done?

SURROUNDINGS AND PROBLEMS EXPERIENCED

25. How do you travel to see community members that you care for?

26. Do you feel safe to travel using this mode of transport and why?
27. Explain how the following factors in the environment you are working in affect your daily work and how you work around it:
    27.1. Poverty (lack of food and clothing)
    27.2. Lack of basic facilities such as water, electricity and poor sewerage
    27.3. Poor road conditions
    27.4. High crime rate
28. What other environmental factors affect your daily work? Explain to what extent you are affected and how you work around it.

TECHNOLOGICAL ASPECTS

SOLUTIONS FOR DATA CAPTURING (for health care workers not using mobile devices)

29. How comfortable would you be using a mobile device to capture data, instead of completing written paperwork - why?
30. Would you consider using the mobile device to be safer than the paper work?
31. If Yes, Why?
32. If No, Why?
33. What do you think are the advantage to using mobile devices for data capturing? Explain.
34. What do you think are the disadvantages to using mobile devices for data capturing? Explain.

SOLUTIONS FOR DATA CAPTURING (for health care workers already using mobile devices)

35. What advantages have you experienced using mobile devices for data capturing?
36. What disadvantages have you experienced using mobile devices for data capturing?
37. Do you feel safe to use it in your daily work?
    37.1. While travelling?
    37.2. While seeing the community members?
38. If Yes, why?
39. If No, why not?
40. Have you worked in an HCBC environment before where mobile devices were not used?
41. If yes, how does it compare?
42. Which do you prefer?

GENERAL

43. Are there any aspects in relation to the use of paper-based forms for data capturing in your daily work that you would like to add to our discussion?
44. Are there any aspects in relation to the use of mobile devices for data capturing in your daily work that you would like to add to our discussion?

APPENDIX B: COMMUNITY HEALTH CARE WORKER CONSENT FORM

RESEARCHER'S DETAILS	
Title of the research project	**A Socio-Technical Perspective on the Use of Mobile Devices for Remote Data Collection in Home Community Based Care in Developing Countries**
Reference number	
Principal investigator	**Miss Angel Shozi**
Address	**NMMU Summerstrand Campus (North), Gardham Avenue, Summerstrand, Port Elizabeth**
Postal Code	**6031**
Contact telephone number (private numbers not advisable)	**041-5043278**

A.1 HEREBY CONFIRM AS FOLLOWS:		**Initial**
I, the participant, was invited to participate in the above-mentioned research project		
that is being done by	Miss Angel Shozi	
from	Faculty of Engineering, the Built Environment and Information Technology	
Of the Nelson Mandela Metropolitan University.		

THE FOLLOWING ASPECTS HAVE BEEN EXPLAINED TO ME, THE PARTICIPANT:			Initial
2.1	**Aim:**	The researchers are studying how cell phones can be used in the Home Community Based Care environment to help improve the work that is being done by the Health Care Worker. The information that will be collected from the health care worker will be used to compile a set of guidelines. These guidelines will set out how these mobile devices can be used in the easiest way possible. By creating these guidelines, the work that is being done by the health care worker will be made simpler by using a cell phone. The guidelines will ensure that the environment the health care worker works in and the device that the health care worker will be using are considered when developing an application to replace paper-based data collection.	
2.2	**Procedures:**	I understand that the researcher will do an interview with me about my work. The interview will be recorded on tape and also on video but only if I have given consent. During the interview, I will be required to explain the daily operations of my work and explain to the researcher the steps I take when I visit a citizen in the community. I will be required to explain the way in which I capture the data whether it be written or electronic. The researcher will accompany me on an HCBC visit in order to watch the work that I do in the community. This will be captured using a video recorder, if I and the other participants have given consent.	
2.3	**Risks:**	I understand that there is a risk that citizens may feel embarrassed to have a stranger accompanying me on an HCBC visit and that I have to help the researcher to obtain the citizen's permission. If this is not possible, I understand that I will discuss/describe the part of my work to the researcher where they were not able to watch me work.	
2.4	**Possible benefits:**	I understand that by participating in this research study, the work that I do may be improved in the future through usable and useful applications being created to capture data using a cell phone.	
2.5	**Confidentiality:**	I understand that my identity will not be revealed in any discussion, description or scientific publications by the researcher. However, I may choose to participate in the making of a video, in which my identity will be captured in the video. If I prefer, my identity can be disguised in the video to avoid my face being recognized.	
2.6	**Access to findings:**	Any new information or benefit that develops during the course of the study will be shared as follows: - Letter to the NGO / Hospice supervisor - Orally in group discussions	

2.6	**Voluntary participation / refusal / discontinuation:**	My participation is voluntary	**YES**	NO	
		My decision whether or not to participate will in no way affect my present or future care / employment / lifestyle	**TRUE**	FALSE	

3. THE INFORMATION ABOVE WAS EXPLAINED TO ME/THE PARTICIPANT BY:								**Initial**
Miss Angel Shozi								
in	**Afrikaans**		**English**		**Xhosa**		**Other**	
and I am in command of this language, **or** it was satisfactorily translated to me by								
(name of translator)								
I was given the opportunity to ask questions and all these questions were answered satisfactorily.								

4.	No pressure was put on me to agree to participate and I understand that I may stop participating at any stage without being punished.	

5.	Participation in this study will not result in any additional cost to myself.	

A.2 I HEREBY VOLUNTARILY CONSENT TO PARTICIPATE IN THE ABOVE-MENTIONED PROJECT:					
I will participate in the making of the video.	**YES**	**NO**	My identity must be disguised to avoid facial recognition.	**YES**	**NO**
Signed/confirmed at			On	20	
Signature or right thumb print of participant			Signature of witness:		
			Full name of witness:		

A. STATEMENT BY OR ON BEHALF OF INVESTIGATOR(S)								
I,	Angel Shozi			declare that:				
1.	I have explained the information given in this document to			(name of participant)				
	and / or his / her representative			(name of representative)				
2.	He / she was encouraged and given ample time to ask me any questions;							
3.	This conversation was conducted in	**Afrikaans**		**English**		**Xhosa**	**Other**	

	And no translator was used OR this conversation was translated into		
	(language)	by	(name of translator)
Signed/confirmed at		On	20
Signature of interviewer		Signature of witness:	
		Full name of witness:	

B. DECLARATION BY TRANSLATOR (WHEN APPLICABLE)

I,	(full names)		
ID number			
Qualifications and/or			
Current employment			
confirm that I:			
1.	Translated the contents of this document from English into	(language)	
2.	Also translated questions posed by	(name of participant)	as well as the answers given by the investigator/representative;
3.	Conveyed a factually correct version of what was related to me.		
Signed/confirmed at		On	20
I hereby declare that all information acquired by me for the purposes of this study will be kept confidential.			
Signature of translator		Signature of witness:	
		Full name of witness:	

C. IMPORTANT MESSAGE TO PARTICIPANT

Dear participant
Thank you for your participation in this study. Should, at any time during the study:

- an emergency arise as a result of the research, or
- you require any further information with regard to the study, or
- the following occur

You think of any additional information to add.

Kindly contact	Miss Angel Shozi
at telephone number	0793847649 (The researcher will phone back at her own cost).