

**A PATHWAY THROUGH WHICH MHEALTH OUTCOMES ARE
PRODUCED FOR MATERNAL HEALTHCARE CONSUMERS IN A
DEVELOPING COUNTRY CONTEXT**



BY

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DECLARATION

I hereby declare that the thesis

**A PATHWAY THROUGH WHICH MHEALTH OUTCOMES ARE PRODUCED FOR MATERNAL HEALTHCARE
CONSUMERS IN A DEVELOPING COUNTRY CONTEXT**

is my own work, and all sources have been acknowledged through referencing.

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Mphatso Exlysa Nyemba-Mudenda

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DEDICATION

To my husband, Dale; and our three beautiful children: Chileleko, Mukuzike, and Twapegwa

and

*To the memory of my late father, Hexley Elliot Sonjo Nyemba
1949-2011*

ABSTRACT

Problem Statement: The use of mobile technology in health (mHealth) has been ascribed as transformative power in the health systems of the developing countries, especially for improving healthcare delivery in rural areas. However, the full potential of mHealth has not been realised and there is a dearth of evidence on effectiveness and impact. This has limited informed policy-making, affecting the buy-in from investors and policy makers, and limiting adoption and scaling up of mHealth interventions that could benefit rural communities.

Purpose of the research: The main objective of this study was to examine how mHealth interventions contribute to maternal health outcomes in a developing country context, at a micro level. The specific aims were to examine how mHealth outcomes for maternal health consumers in rural communities are produced and how variations in outcomes can be explained.

Design/methodology/approach: The study adopted a critical realism approach, and drew on Capability Approach as a theoretical lens, with the aim to explain how and why mHealth interventions work in maternal health, for whom, and in what circumstances; by analysing patterns between context, mechanisms and outcomes. Data for this research was obtained through semi-structured interviews with users of mHealth in maternal healthcare in Malawi, and various project stakeholders. Project documents were also used as secondary data.

Findings: mHealth interventions may affect maternal health outcomes and service delivery through multiple mechanisms. Three different types of mechanisms were found to produce mHealth outcomes for women in maternal health. These were: Technology adoption mechanisms that led to the uptake and adoption of mHealth services in maternal health; agential mechanisms that facilitated agency of consumers in achieving health goals; and health system mechanisms for realisation of desired health outcomes. A myriad of personal, socio-cultural, and environmental factors either activated or inhibited the mechanisms, resulting in varied outcomes for the women.

Originality/contribution: mHealth as a complement to existing maternal health services can lead to improvement in consumer behaviour and experiences, and even clinical outcomes. This research has highlighted a pathway through which mHealth outcomes are produced for consumers in maternal health. This process starts from mHealth acceptance and adoption as a technology by the consumers; to women acting as agents of their own health by utilising the opportunities generated by mHealth; and finally health system efficiencies for provision of adequate care to the women. This understanding of how mHealth works in maternal health can improve design and operations of such interventions for effectiveness that may lead to the realisation of its full potential.

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RESEARCH PUBLICATIONS RELEVANT TO THIS THESIS

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2. Chigona, W., **Nyemba-Mudenda, M.**, & Metfula, A. (2012). A review on mHealth research in developing countries. *Journal of Community Informatics*, 9(2), <http://ci-journal.net/index.php/ciej/article/view/941>
3. Makoza, F., Chigona, W., & **Nyemba-Mudenda, M.** (2014). Analysis of Online Media on Social Inclusion in Maternal Health Discourse. *Journal of Health Informatics in Developing Countries*, 8(1).
4. **Nyemba-Mudenda, M.** & Chigona, W. (2015). mHealth drivers for maternal health outcomes in developing countries: A systematic review. *In proceedings of the 13th International Conference on Social Implications of Computers in Developing Countries*, Negombo, Sri Lanka, May 2015. http://ifipwg94.org/files/IFIPWG94_2015_PROCEEDINGS.pdf
5. **Nyemba-Mudenda, M.**, & Chigona, W. (2013). The Dynamics of Involving Intermediaries on the Outcomes of Mobile for Development Initiatives: The case of a maternal healthcare intervention in Malawi. *In Proceedings of Health Informatics South Africa (HISA) 2013 Conference*, Port Elizabeth: South Africa.

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LIST OF ACRONYMS

ANC	Antenatal Care
CA	Capability Approach
CHW	Community Health Worker
EDD	Expected Date of Delivery
eHEALTH	Electronic Health
FGD	Focus Group Discussion
GDP	Gross Domestic Product
HIV/AIDS	Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome
HSA	Health Surveillance Assistant
HLWs	Hotline Workers
ICT	Information and Communication Technologies
ICT4D	Information and Communication Technology for Development
ICT4H	Information and Communication Technology for Health
IS	Information Systems
ITU	International Telecommunication Union
IVR	Interactive Voice Response
M4D	Mobile for Development
MCH	Maternal and Child Health
MDG	Millennium Development Goal
mHEALTH	Mobile Health
MMR	Maternal Mortality Rate
MNCH	Maternal, Neonatal, and Child Health
MoH	Ministry of Health
MRT	Middle-Range Theory
MSSM	Mobile System for Safe Motherhood
MoTeCH	Mobile Technology for Community Health Initiative in Ghana

NSO	National Statistical Office
NGO	Non-Government Organisation
PMCT	Prevention of Mother to Child Transmission
SIM	Subscriber Identity Module
SLF	Sustainable Livelihood Framework
SMS	Short Message Service
TAM	Technology Acceptance Model
TB	Tuberculosis
TBA	Traditional Birth Attendant
UN	United Nations
UNICEF	United Nations Children's Fund
WCBA	Women in Child-Bearing Age Group
WHO	World Health Organisation
WSIS	World Summit on the Information Society

GLOSSARY OF TERMS

eHealth	The use of electronic processes and communication to support healthcare practice
Expected date of delivery	An estimation of a date a woman is expected to give birth. It is calculated from the date of last menstruation period. Women usually give birth about 2 weeks before or after the estimated date.
Health informatics	The science of information communication technology application to healthcare practice
Information and communication technology	A term that includes any device or application that supports the process of communication; or gathering, processing, and disseminating information
Information systems	The collection of technical and human resources for gathering, storing, and processing, and disseminating information
Maternal health	Health of women during pregnancy, childbirth and the postpartum period, which includes family planning, preconception, prenatal and postnatal care
Maternal morbidity	Illness and complications in pregnancy
Maternal mortality	Death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes
Maternal mortality rate	Annual number of women deaths per 100 000 live births from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes
Midwife	A skilled health personnel trained to assist women in childbirth
mHealth	The use of mobile communication devices to deliver health services and information
Mobile for development	The use of mobile communication devices, mostly mobile phones, to support economic growth and socio-political transformation in developing countries
Mobile phone penetration rate	Number of mobile cellular subscriptions per 100 people
Mobile technology	An extension of computing and the Internet into wireless medium, which allows users to have access to information and applications anytime and anywhere
Obstetric care	Management of normal and complicated pregnancy, childbirth and postpartum period. Usually provided by a doctor specialising in obstetrics and gynaecology.

Perinatal services	Services offered to both mother and baby from five months before and one month after birth
Postnatal services	Regular check-ups for mother and baby within 24 hours of delivery and at designated periods up to 42 days after delivery, to prevent deaths due to complications or infections arising from delivery
Prenatal (Antenatal) care services	Routine check-ups for prevention and early detection of complications in pregnancy; and promotion of a healthy lifestyle for both mother and child
Safe Motherhood	A worldwide initiative with the aim of ensuring that every woman has access to appropriate healthcare during pregnancy, delivery, and six weeks after childbirth
Ubiquitous computing	Access to information and applications using wireless digital devices anywhere and anytime

1 INTRODUCTION

1.1 Introduction

On World Telecommunication and Information Society Day in 2010, the United Nations Secretary-General, Ban Ki-moon said *“In today's world, telecommunications are more than just a basic service – they are a means to promote development, improve society and save lives”* (United Nations, 2010). This research focuses on the evaluation of health-related services via mobile communication in the delivery of maternal health services, with the potential to save lives in developing countries. This chapter is an overview of the study. The chapter presents the background of the study, the purpose, and objectives of the study, the research problem, the research questions, and the research approach.

1.2 Background to the study

Maternal health denotes the wellbeing of women during pregnancy, childbirth, and postpartum period (WHO, 2010). Ideal maternal healthcare services provide women with information on health practices in family planning, pregnancy care and childbirth; appropriate prenatal care; emergency obstetric care, delivery under supervision of skilled attendant; and postnatal care (Adam et al., 2005; WHO, 2009; WHO, 1996). Such services are scarce in developing countries due to limited availability of basic public health services leading to high maternal mortality rates (MMR) (WHO, 2010). Over 75% of maternal mortality and morbidity are preventable, however about 300 000 women die from pregnancy and birth-related complications each year (WHO, 2010; WHO, 2012).

Millennium Development Goal (MDG) number 5 calls for an improvement in maternal health by reducing maternal mortality and increasing access to reproductive health by the year 2015. To date, most developing countries, especially those in Africa, are lagging behind their targets. This is mainly due to the challenges faced by health systems in developing countries, including poor access to health information and health services. There is need for new strategies and innovations to help countries attain MDG 5. In trying to meet the target, the international community aims at leveraging technological innovations for efficient

delivery of healthcare services and the provision of health information to consumers (WSIS (World Summit on the Information Society), 2005). Governments and development agencies in developing countries view mobile technology as a potential Information and Communication Technology (ICT) tool for development and improving livelihoods (Aker & Mbiti, 2010; Duncombe, 2011). In addition, Mobile for Development (M4D) initiatives recommend mobile phones as a means to improve maternal health services, as they are readily available, even in poorly-resourced settings (mHealth Alliance, 2010).

Mobile technology utilisation is growing at a rapid rate globally, including in the developing countries. By the end of the year 2010, the world had 5.3 billion mobile subscriptions, and 3.8 billion of these connections were in the developing world (ITU [International Telecommunication Union], 2011b). Even in the poorest communities, most people either own or have access to a mobile phone. Since the use of mobile phones is less expensive than the traditional landline and standard Internet, mobile technology has had a socio-economic impact in the developing countries, and its pervasive social connectivity has imperative implications, even on healthcare and public health by promoting health, and preventing and managing diseases (Aranda-Jan, Mohutsiwa-Dibe & Loukanova, 2014; Mechael et al., 2010). Mobile technology is being used to detect and respond to disease outbreaks and natural disasters in most parts of the world, hence promoting health and preventing diseases (Cole-Lewis & Kershaw, 2010; Morris, 2009). Mobile health (mHealth) is the use of mobile communication devices, such as mobile phones, to deliver healthcare. Text messaging, video messaging, voice calling, and Internet are some of the mobile phone technologies that have been utilised in mHealth to improve the access and quality of health information and services (Ashar et al., 2010; Banerjee & Hsi-Shi Leong, 2006; Chi & Stringer, 2010; Chib, Lwin, Ang, Lin & Santoso, 2008; DeRenzi et al., 2011; Kijisanayotin, Pannarunothai, & Speedie, 2009).

In a number of studies in both developed and developing countries, mobile technology has shown to improve the prevention and early detection of communicable diseases by advancing dissemination of knowledge through advocacy, awareness, education information, counselling, and support (Banerjee & Hsi-Shi Leong, 2006; Blake, 2008; Chi & Stringer, 2010; Chib et al., 2008; De Tolly, Skinner, Nembaware & Benjamin, 2012;

Kijsanayotin et al., 2009; Lee, 2011; Ramesh et al., 2008). Furthermore, mHealth has shown improvements in medical test results delivery, patient-provider communication, health information communication, remote diagnosis, data collection, disease and emergency tracking, and access to health records (Ashar et al., 2010; Cole-Lewis & Kershaw, 2010).

1.3 Research problem

Despite the international and national initiatives such as Safe Motherhood and Prevention of Mother to Child Transmission (PMCT), which have introduced technical interventions encompassing emergency obstetric care, skilled workers and attendance, management of unsafe abortion, focused antenatal care, and family planning services; high MMR still remains a challenge in most developing countries (Hogan et al., 2010; WHO, 2012). In developing countries, these programmes and interventions face many socio-economic, political, and cultural challenges or barriers including poverty, gender inequality, distance to clinic for patients, lack of family support for pregnant women, stigma, and health workers' attitudes (Kasenga, Hurtig & Emmelin, 2010; Krishna, Boren & Balas, 2009). In addition, there is inadequate data collection and systems for monitoring implementation, impact and MMR, which are essential to inform decision making, planning and resource allocation, and to identify effective approaches and track quality of care and equity (Human Rights Watch, 2011; Prata, Sreenivas, Vahidnia & Potts, 2009).

As demonstrated in Figure 1-1, the main barrier to accessing healthcare services in maternal health is delay (i) in decision making to seek care, (ii) in arriving at a health facility, and (iii) in receiving appropriate care upon arrival (mHealth Alliance, 2010; Noordam, Kuepper, Stekelenburg & Milen, 2011). The delays may be due to lack of information, inadequate services, the position of women in society, distance, weak health systems, poverty, lack of education, lack of political commitment, or cultural practices (Noordam et al., 2011).



Figure 1-1: Delay as a barrier in seeking maternal healthcare in developing countries

Source: Noordam et al. (2011)

The technical interventions mentioned in the previous paragraph have managed to reduce the MMR to some extent. Nevertheless, effective communication among health workers or between patients and healthcare providers could help in reducing the delay, and the use of mHealth can expedite the process of accessing healthcare in maternal health. There is a broad agreement in research that communication and communication technologies are essential for improving access and quality of maternal health services, as well as overall health outcomes, by providing informational support and regular care (Klasnja & Pratt, 2012; Kreps & Neuhauser, 2010; Krishna et al., 2009; Noordam et al., 2011; Tezcan, Von Rege, Henkson, & Oteng-Ntim, 2011). In addition, mHealth such as text messages has shown to improve maternal health by changing the attitude and behaviour of pregnant mothers in developed countries (e.g. Evans, Wallace, & Snider, 2012; Gazmararian, Elon, Yang, Graham, & Parker, 2014). Hence, the use of mobile technology interventions for mass communication and disseminating information to the communities, even at an individual level of one woman, together with the existing interventions, seem to have a wide scale impact on reducing maternal mortality in developing countries, even though there is not as yet any study-based evidence (Noordam et al., 2011; Tamrat & Kachnowski, 2012).

Current mHealth projects in maternal health have enhanced their services from just focusing on emergencies such as life-threatening situations, to using mobile phones in delivering mass health educative messages to pregnant women; free-toll lines for support; appointment booking systems; and also monitoring systems for recalling women with risk factors to present themselves at an antenatal clinic and/or referring them for specialist attention (Lim et al., 2011; Lund, 2009; Tezcan et al., 2011). The nomological net in Figure 1-2 demonstrates the processes and interactions in the implementation and usage of mHealth

interventions. In design and implementation of mHealth projects, different stakeholders such as donors, development agencies, the government, and health workers coalesce with community participation to devise interventions that meet the needs and realities of the local settings.

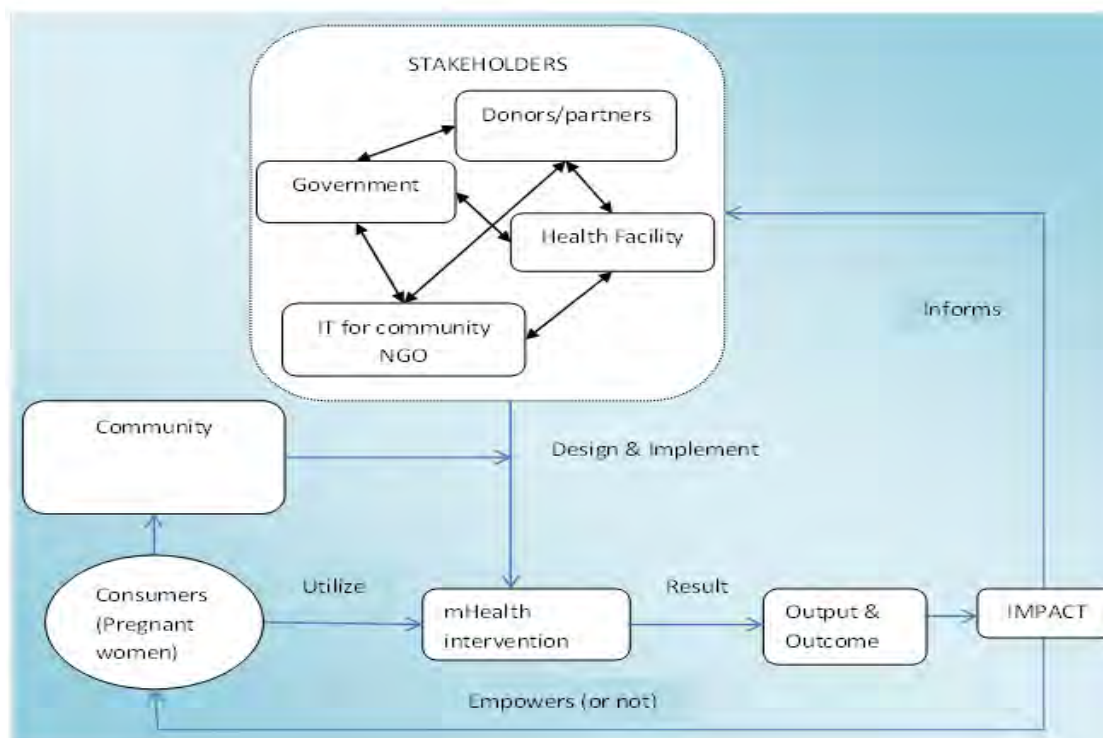


Figure 1-2: Nomological net - Scope of the study

In this case, the direct beneficiaries of the intervention are women in the child-bearing age group. These women use mobile technology-based services e.g. to receive educative messages on maternal care via a mobile phone, resulting in intended or unintended output and outcomes, which could be health related or for the benefit of overall well-being. On one hand, the outputs could include new patterns, actions, or transactions realised from the intervention. On the other hand, the outcomes are the benefits (or detriments) of using mHealth services that can be quantified or analysed qualitatively (Heeks, 2010). The impact from these outcomes could empower the consumer and inform the stakeholders.

mHealth initiatives seem to have tremendous potential to improve access and quality of maternal health. However, still lacking in the body of mHealth literature are studies evaluating the effectiveness and impact of these interventions on the healthcare system and

among clients (Aranda-Jan et al., 2014; Chib, van Velthoven & Car, 2014; Mechael et al., 2010). Most of the studies conducted in the field so far only focus on the feasibility, implementation, adoption, usage, and acceptability of the technology (Chib, 2010; De Tolly et al., 2012; Kijsanayotin et al., 2009; Lim et al., 2011). A few projects have been evaluated to assess health and patient outcomes as well as business outcomes of the interventions (e.g. Lund et al., 2014b; Oyeyemi & Wynn, 2014). However, these studies use health indicators, which show negligible impact; which could be due to mHealth projects being in their infancy, or pilot projects and small-scale implementation with limited reach that run for a short period to deal with a specific problem, such as a tuberculosis (TB) pandemic in an area (Mechael et al., 2010).

What has not been analysed thoroughly so far is the effectiveness of mHealth, the impact it has on the healthcare system and the consumers, and how it contributes toward sustainable social change and human development; thus evaluating the outcomes based on consumers' capabilities and the process taken to achieve the outcomes. This thesis argues that understanding the processes and factors involved in mHealth implementation can pave way to assessing mHealth effectiveness before we can get to using health indicators. Thus, evaluation of mHealth interventions should not only focus on measuring health and patient outcomes using health indicators or financial cost benefit analysis, but rather on using agile and valid conceptual frameworks that explain how mHealth outcomes are produced and contribute to health outcomes, social change, and overall quality of life. Therefore, the study proposes that an analysis of mHealth interventions should look at how and why mHealth has the potential to cause change in maternal health, for whom and in what circumstances (the context).

1.4 Research purpose

The study intends to investigate the process through which mHealth interventions contribute to maternal health outcomes. The study takes into account that maternal health is a sensitive domain where social inequality affects a pregnant woman's autonomy, her choices in health matters, and overall quality of life; especially in rural areas (Kyomuhendo, 2003; Lori & Bolye, 2011; Maimbolwa, Yamba, Diwan & Ransjö-Arvidson, 2003). Hence, the

study will examine the opportunities that mHealth generates for the women in maternal health and how the women utilise the opportunities into desired health outcomes. The study further seeks to examine how mHealth relates to the gender discrepancies associated with poor maternal health, and comments on the honesty of the discourse. Therefore, the main objective of this study is to examine how mHealth interventions contribute to consumer outcomes in maternal health in a developing country context at micro level. The specific aims are to examine how mHealth outcomes for maternal health consumers in rural communities are produced and how variations in outcomes can be explained. To fulfil this objective, the study will evaluate a mHealth intervention, starting from the point where women access mHealth services, to the dynamics that mediate the realisation of intervention and health outcomes, to the achievement of maternal health outcomes (or lack thereof).

The claims of this research emanate from the following studies:

- Chib et al. (2014) who highlight the paucity of theoretical mechanisms and explanation for technology adoption on the pathway of realising mHealth outcomes. In addition, they assert that no study so far has explained the entire pathway from mobile phone use to health outcomes.
- The work of Mechael et al. (2010) who call upon public health and computer science researchers to evaluate the effectiveness of mobile technology for health intervention, and develop standardised indicators (process and outcome) for monitoring and evaluating mHealth effectiveness and impact at different levels of the health system and among clients
- Chib (2010) who calls upon both cost benefit analysis and social benefit analysis of mHealth, in addition to the direct impact on maternal health that could provide critical evidence for policy makers to base future investment decisions for sustainability and scalability
- Lucas (2008) who calls for the need to assess impact of mobile phone interventions in health, on different stakeholders i.e. health providers, managers, administrators,

and consumers – to determine how they are likely to respond and what might encourage them to support or oppose an innovation

The study aims to help designers and developers of m-solutions, implementers of mHealth interventions and policy makers, understand better the factors that affect the acceptance and use of mobile phone technology from the public health consumer perspective, and how mHealth contributes to maternal health. Even though the study will look at mHealth interventions in the domain of maternal health, maternal health services, like all reproductive health services, are part of an integrated healthcare package rather than a stand-alone service, so the findings can be used to gain insights into the health system as a whole.

1.5 Research questions

Recent reviews of mHealth adoption in low-resource environments show that there is a paucity of theory explicating the process of technology adoption, in association with sociological determinants of health outcomes to explain how and why mHealth interventions work to contribute to health outcomes (Aranda-Jan et al., 2014; Chib et al., 2014). The main interest for this research is to address the lack of evidence in the effectiveness of mHealth in the developing world by explaining why women would use mobile phones for maternal healthcare needs, linking technological input to health outcomes. To evaluate the effect of mHealth in maternal healthcare in developing countries, this study intends to conduct in-depth analysis of the processes and interactions that take place from using the mobile phone technology to achieving outcomes, intended or unintended. The interactions within the processes will elucidate why (or why not) consumers use mHealth; the mechanisms through which the health outcomes are derived.

The thesis therefore intends to find answers to this research question: ***How are maternal health outcomes achieved through the use of mobile phones by women in developing countries?*** This research question will be answered through the sub-questions presented in Table 1-1:

Table 1-1: Research sub-questions and their corresponding objectives

Sub-question	Objective
What are the effects of mHealth in maternal healthcare for women in rural Malawi?	To understand the effects of mHealth on maternal health outcomes for women in the child-bearing group as consumers of maternal health
How do contextual factors influence the realisation of mHealth outcomes in maternal healthcare for the women in rural Malawi?	To analyse the mediation of contextual dynamics in the realisation of both mHealth outcomes and maternal health outcomes
What causes mHealth outcomes for maternal healthcare consumers in rural Malawi?	To uncover the underlying causes of the mHealth outcomes for women in maternal health

The sub-questions were designed to understand the mechanisms through which mHealth affect maternal health outcomes for the women, and the actual outcomes that are realised, whether intended or unintended.

1.6 Research approach

The perspective of this research is that mHealth has the potential to contribute to human development in developing countries. Therefore, the effects of mHealth should not be measured according to the health indicators only, but should also focus on opportunities, both tangible and intangible, that mHealth can generate to enhance or inhibit human capabilities. Technical, as well as socio-economic, cultural, and political factors, which are embedded in local realities for adoption and usage of mobile phone technology or service, should be investigated to assess how they facilitate the generation of opportunities and their utilisation into desired outcomes, to maximise benefits of the mHealth interventions.

The study is qualitative and critical, drawing upon the critical realist approach and Amartya Sen's capabilities approach (CA), with the aim to explain how mHealth interventions work, for whom, and in what circumstances (McGrath, 2013; Smith & Seward, 2009). CA is a normative framework for the evaluation and assessment of individual well-being and social arrangements, the design of policies and proposals about social change in society (Robeyns, 2005a, p.94). This analytical tool assesses human well-being in the space of capabilities. In critical realism, CA assumes a relational social ontology, where capabilities of an individual are seen as causal powers for a person to act in a certain way. Thus, in Information and Communication Technology for Development (ICT4D) initiatives, these causal powers are produced by social structures that emerge from relations between people, and relations

between people and technology (Oosterlaken, 2011; Smith & Seward, 2009). The combination of critical realism and CA facilitates the analysis of patterns between mechanisms, context, and outcomes. The use of CA allows for an evaluation of both the means and ends of the mHealth intervention. In addition, in ICT4D domain, CA does not only examine the technical aspects, but has potential to tease out social constituents that contribute to human wellbeing (Hatakka & De', 2011; Zheng, 2009).

To answer the research questions presented above, an empirical investigation was conducted to understand the actors, structures, agencies, and dynamics involved in mHealth use in maternal healthcare in Malawi. The study used Mobile System for Safe Motherhood (MSSM)¹ intervention as a case. Malawi is one of the countries at the bottom of the Human Development Index list, with about 50% of the population living below the poverty line (Malawi NSO, 2012b). Maternal healthcare service delivery is a challenge to the resource-constrained government of Malawi, with problems ranging from critical shortages of health personnel; poor quality of the health services; to poor and inadequate health facilities (Bowie & Geubbels, 2013; Ministry of Health [Malawi], 2005). As a result, MMR for Malawi stands at 675 deaths per 100,000 live births, which is among the highest in Sub-Saharan region (Malawi NSO & ORC Macro, 2011). Malawi was chosen as a case for the study due to its high MMR, and the government's commitment to improve maternal health (Bowie & Geubbels, 2013; Makoza, Chigona & Nyemba-Mudenda, 2014; Ministry of Health [Malawi], 2005). The government of Malawi has allowed a number of mHealth projects to be piloted in maternal and child health (MCH) in an attempt to meet the MDG 5 target.

Data for this research was obtained using semi-structured interviews with 32 stakeholders of the MSSM project, two focus group discussions with the mothers as beneficiaries of the intervention, and participant observations. Project documents from the implementing agency and the Internet were also collected and analysed.

¹ A pseudonym is used for anonymity

1.7 Benefits of the study

The research makes three types of contributions: theoretical, methodological, and practical. A theoretical contribution emerges from the use of CA as an explanatory theory of mHealth in maternal health, and the integration of a number of theories within CA to enhance its explanatory power for ICT4D initiatives. Further, the study adds to the body of knowledge on mHealth in ICT4D research. The methodological contribution is twofold. First, the research provides an exemplar of an empirically grounded case study underpinned by a critical realist philosophy. Second, the research demonstrates how critical realism and CA are complementary and mutually enriching, especially in addressing the common criticism of theory-data gap in CA. The practical contribution emerges from the application of the findings to an exploration of existing or potential strategies to address the issue of mHealth effectiveness in developing countries.

In summary, the research is of significant value in the following four ways:

1. To the research community, the research adds knowledge to the mHealth domain where there is little research, and it draws on both empirical and theoretical insights to develop an emerging theory and associated conceptual framework.
2. The study is significant to maternal health consumers in Malawi and other developing countries because it provides the women with a voice, and insights on how to support them in leveraging both mobile technology and maternal healthcare.
3. The research is significant to policy makers and practitioners developing and implementing strategies to enhance access to maternal health information and healthcare services through mobile communication, because it links empirical and theoretical insights to existing strategies. The research identifies mechanisms and influences that can be addressed to enhance the effectiveness of mHealth, and foster women's participation in the digital age and contemporary maternal healthcare, which can improve maternal health outcomes in developing countries.
4. It could be significant to the wider social domain because insights can help to address social discrepancies and social inequalities surrounding technology use, maternal health, and women in general in developing countries.

1.8 Structure of the thesis

The thesis has eight more chapters, and the structure of the thesis is as follows:

Chapter 2 presents the literature survey with the aim of situating the research within existing theories. It begins with an overview of maternal health followed by a systematic review of literature on maternal health in developing countries. The terrain of ICT4D is presented, describing the topics of ICT4D evaluation, empowerment through ICT, Mobile for Development (M4D), and mHealth in developing countries. The literature review helps to identify areas to which the study may contribute, thus the chapter concludes with an explanation on how the synthesised literature is coherent with the objectives of the study.

Theoretical approach adopted for the study is presented in Chapter 3. The chapter describes the tenets of both critical realism and capability approach. It further gives a rationale on why the two are compatible and optimal for evaluation of ICT4D, and mHealth in particular. The discussion of capability approach and the review literature on studies that have used capability approach in ICT4D, help to identify the limitations of the framework and how this study could contribute by using it in a different way.

Chapter 4 describes the research methodology of the study. It starts with elucidating the critical realist methodology, highlighting the stages involved in the research process and methods that can be used. For in-depth analysis of the MSSM context, the study adopts qualitative methods, using a case study strategy for which justification is provided. Data collection methods, data analysis methods, validity of findings claims, and ethical considerations are also presented.

The case description in Chapter 5 introduces the social and historical background of the research. It gives details and preliminary research findings on MSSM intervention through the explication of events and outcomes, some processes and interactions leading to these outcomes, and the underlying structures with potential powers to produce the outcomes.

Chapter 6 draws from empirical and theoretical insights to describe mHealth contribution to women's capabilities in maternal health. The chapter starts with a description of a health

capability in maternal health. It then delineates how mHealth can enhance the health capability in maternal health. To understand and explain the processes through which mHealth contributes to maternal health outcomes, theories of technology adoption, agency, and the health system are integrated into capability approach; this helps with the conjecturing of the mechanisms with potential to produce the outcomes.

The results and findings from the corroboration of the mechanisms in the case of MSSM are presented in Chapter 7. The case analysis demonstrates how the mechanisms manifest in the context of MSSM.

Chapter 8 discusses and examines the implication of the findings for the three key theoretical concepts of context, mechanisms, and outcomes, in relation to capability approach as an explanatory theory; and in so doing answers the research questions.

The thesis concludes in Chapter 9, first by giving the overview of the research findings, which is a summary to the main research question. It also presents the contributions made to theory, methodology, and practice. It further highlights the limitations of the study and future research directions. The chapter and thesis concludes with personal reflections on the research process.

2 LITERATURE REVIEW

2.1 Introduction

This chapter expands on the rationale for the study given in the previous chapter, and it situates the research in literature of three relevant domains to this thesis: maternal health in developing countries, ICT4D, and mHealth in developing countries. The chapter starts by reviewing discourses on maternal health in developing countries; it highlights maternal health trends, the dynamics contributing to high MMR, and its impact on development. A section on ICT4D is followed by different approaches to evaluating ICT4D programmes, and a justification of why the study adopted the development approach. Then a conceptualisation of empowerment as a process of development is presented, followed by ICT and empowerment of women, given that maternal healthcare consumers are women.

The chapter also presents a terrain of Mobile for Development (M4D), and reviews current studies on the use of mobile phones in health. It further presents the landscape of mHealth in maternal healthcare in developing countries, and concludes with a summary on how the reviewed and synthesised literature is coherent with the aims of this study.

2.2 Maternal health

Maternal health refers to the health of women during pregnancy, childbirth, and the postpartum period, which includes family planning, preconception, prenatal, and postnatal care (WHO, 2012). WHO (2010, p.4) defines maternal mortality as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. Maternal complications and deaths are highest in the third trimester, and they cluster around labour and the postpartum period, but high risk of death continues to six months after delivery (Nanda, Switlick, & Lule, 2005; Prata et al., 2009; Ronsmans & Graham, 2006). The three common factors that determine the risk of maternal mortality are likelihood of a pregnancy occurring, likelihood of a complication arising, and successful management of a complication (Bowie & Geubbels, 2013).

To reduce maternal morbidity and mortality, health systems worldwide offer a broad range of maternal healthcare services including contraceptive care, abortion care, obstetric care, and perinatal care, as illustrated in Figure 2-1.

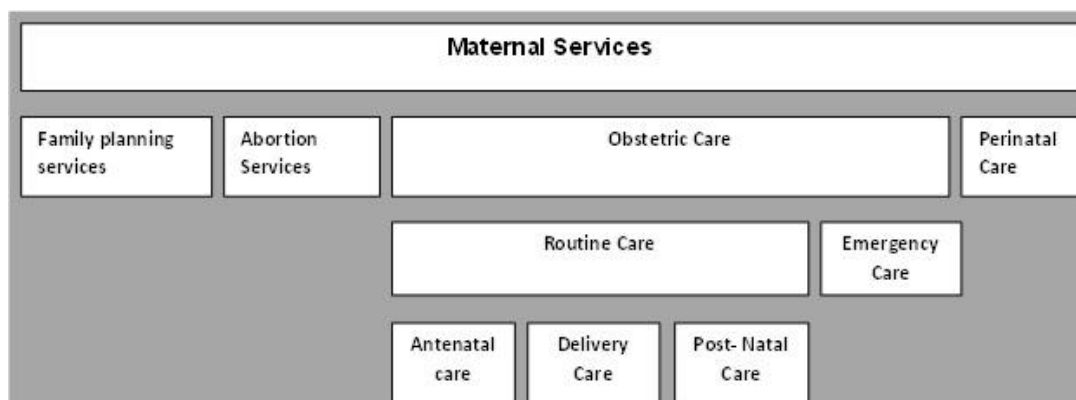


Figure 2-1: Scope of maternal health services
Source: Penn-Kekana & Blaauw (2002)

Maternal services encompass improving access to contraceptives, and also providing safe abortion and post-abortion care so as to reduce deaths from unsafe abortions (one of the direct causes of maternal deaths) (Prata et al., 2009).

Care of a woman during and after pregnancy is generally referred to as obstetric care. It could be routine e.g. Antenatal Care (ANC) or emergency in case of complications (WHO, 2010). Postnatal care is a check-up a woman and baby receive regularly within 24 hours of delivery and at designated periods up to 42 days after delivery. Postnatal check-ups help to prevent deaths due to complications or infections arising from delivery. Perinatal care refers to services offered to both mother and baby from five months before and one month after birth (Lund et al., 2014b).

2.2.1 Trends in maternal mortality

While the majority of women have been enjoying the benefits of Safe Motherhood worldwide since 1987 (Freedman et al., 2007), about 800 women die every day from pregnancy and childbirth-related complications (WHO, 2012). Maternal mortality is unacceptably high, ranging between 210 000 – 358 000 every year, and 99% of these maternal deaths occur in developing countries (Hogan et al., 2010; WHO, 2010; WHO, 2012). Sub-Saharan Africa accounts for half of the maternal deaths in developing countries,

with an MMR of 500 deaths per 100 000 live births; which is higher than any other region. This is shown in Figure 2-2. The risk of a woman dying from pregnancy-related complications in her lifetime is about 1 in 150 women in the developing countries compared to about 1 in 3 800 in industrialised countries (WHO, 2012). Life-time risk of maternal deaths in developing countries is high because of high mortality rates, coupled with high fertility rates (Bowie & Geubbels, 2013).

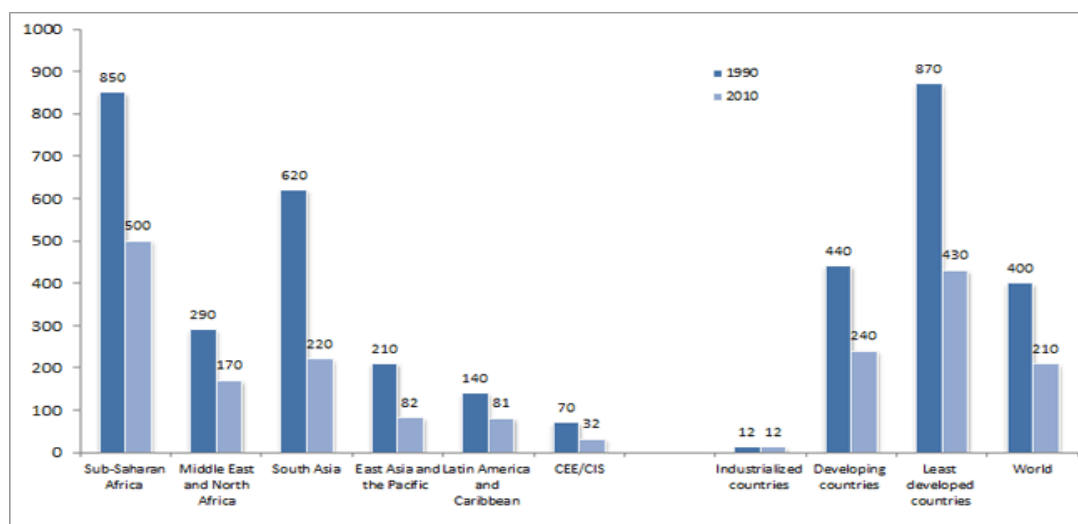


Figure 2-2: Trends in maternal mortality: 1990-2010
Source: WHO (2012)

The majority of maternal morbidity and mortality are avoidable, but the progress made so far in reducing MMR is negligible. The global decline rate of MMR from levels in 1990 was at 47% in the year 2010, compared to 34% in 2008 (Hogan et al., 2010; WHO, 2010; WHO, 2012). Hogan et al. (2010) assert that reducing MMR by 75% by 2015 still remains a challenge and is unlikely to be achieved.

Most countries in Sub-Saharan Africa are not on track to meet MDG 5 targets. South Africa made no progress at all in reducing MMR by the year 2008, but it experienced a fourfold percentage increase in the year 2011 (Human Rights Watch, 2011). The mortality rate in South Africa increased from 150 per 100 000 women in 1998 to approximately 625 per 100 000 women in 2010. The MMR for Malawi skyrocketed from 620 deaths per 100 000 in 1992 to 1 120 deaths in 2000. These huge increases in MMR in Sub-Saharan Africa are attributed to the Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome (HIV/AIDs) pandemic and unreliable evaluations before the year 2000 (Human Rights Watch,

2011; Bowie & Geubbels, 2013). As per 2010 demographic survey results, the Malawi MMR stood at 675; the 2015 target for Malawi is 435 deaths per 100 000 live births (Bowie & Geubbels, 2013; Malawi NSO (National Statistical Office) & ORC Macro, 2011).

For every woman who dies from pregnancy-related complications in developing countries, approximately 30 more suffer injuries, infection and disabilities. Furthermore, diseases such as malaria, anaemia, and HIV/AIDs during pregnancy contribute to maternal deaths e.g. in the year 2008, 9% of maternal deaths in Sub-Saharan Africa were HIV-related (WHO, 2010), and it increased to 10% in 2010 (WHO, 2012). Hogan et al.'s (2010) analysis of maternal mortality data from 1980 to 2008 for 181 countries reflected substantial declines in maternal deaths in Sub-Saharan Africa, and they assert that progress would have been greater if the HIV epidemic had not contributed to substantial increases in maternal mortality in eastern and southern Africa.

2.2.2 Impact of maternal mortality on development

Maternal mortality has an impact on human development in the sense that it affects the overall mortality rate of a country, and this is aggravated by pandemics like HIV/AIDs that increase maternal deaths (Bowie & Geubbels, 2013). Furthermore, maternal deaths have a negative effect on a family's well-being, more especially on young children. Research has shown that only 31% of children born to a deceased mother survive through infancy in Malawi, and their mortality was 3.7% higher than infants with survived mothers (McDermott et al. 1996, as cited in Bowie & Geubbels, 2013). Lastly, women are naturally carers, not just for the family but for the whole community, and in most cultures of developing countries they work hard to provide food for the family; thus maternal death has the potential to impact the socio-economic status of a family, and consequently a country.

2.2.3 Technical interventions to reduce maternal mortality in developing countries

Most pregnancy complications are due to severe bleeding, obstructed labour, high blood pressure, and unsafe abortion during pregnancy. All of these can be treated at a health facility but lead to death in developing countries due to geographical, financial, and human

resource constraints, resulting in poor access to health services especially in low resource settings (Prata et al., 2009). The global consensus to reduce maternal mortality in developing countries started with the integration of maternal health into primary healthcare of health systems that were not focused on maternal health (Hogan et al., 2010). After this was achieved, the focus shifted to training traditional birth attendants (TBAs) and implementing prenatal screening to identify women at risk, but these were not adequate as most complications occur at the time of delivery and cannot be predicted beforehand. In addition, the training did not substantially change the TBAs' belief system and cultural practices (some of which are harmful) (Goodburn, Gazi & Chowdhury, 1995). As a result, the strategy changed to training TBAs as linkage to health facilities, so that they could provide social support to women during childbirth by playing a role in birth preparedness and in strengthening community-based referral practices (Nanda et al., 2005).

The technical interventions currently used in the health systems to improve maternal health outcomes include emergency obstetric care, skilled attendance, management of unsafe abortion, focused antenatal care, and family planning services, as shown in Figure 2-1 (Adam et al., 2005; Penn-Kekana & Blaauw, 2002). About 75% of maternal deaths could be prevented if all women had access to the interventions managing pregnancy and birth complications, especially emergency obstetric care (Hunt & Mesquita, 2008). However, most women do not have access to health services due to delay in (i) recognising the need for medical attention and in the decision-making process, (ii) arriving at a health facility, and (iii) receiving adequate and appropriate care at health facility (Hunt & Mesquita, 2008; Noordam et al., 2011). The main causes of the delays are lack of information, inadequate services, the position of women in society, distance to a health facility, weak health systems, poverty, lack of education, lack of political commitment, and cultural practices (Hunt & Mesquita, 2008; Noordam et al., 2011; Ronsmans & Graham, 2006; WHO, 2010).

2.2.4 Cultural practices and traditional beliefs surrounding pregnancy in developing countries

In all cultures worldwide there are traditional practices and beliefs regarding pregnancy and its outcomes. Mead and Newton (1967), as cited in Choudhry, (1997), found that beliefs

about appropriate behaviour during pregnancy, labour, and the postpartum period existed in all the 222 cultures reviewed; the dos and don'ts in activities, food, care, and behaviour during pregnancy, childbirth, and the postpartum period are all culturally prescribed. The cultural context of childbirth has differing worldviews and realities. In Africa, motherhood is recognised as a socially prominent role since continuation of lineage is deeply rooted in the culture. The expectation for most girls is that one day they will marry and become a mother. Older women teach young women these customs from a tender age; thus these norms influence their attitudes, values, and interpretations of personal and interpersonal experiences, and shape mothering behaviour (Choudhry, 1997; Choudhury & Ahmed, 2011; Lori & Bolye, 2011). In developing countries, pregnancy is often viewed as a normal physiological phenomenon not requiring any intervention from healthcare professionals. Throughout the entire childbearing period, the older women of the family and/or community provide information, guidance, and assistance. A visit to a health facility is necessary only when there is a problem, and women have to seek permission from the husband or older women (Kyomuhendo, 2003; Maimbolwa et al., 2003; Selepe & Thomas, 2000; Wilkinson & Callister, 2010).

With evidence from most Sub-Saharan African countries (for example Nigeria, Liberia, Uganda, Malawi, Tanzania, and Zambia) and also elsewhere in Asia (e.g. India, Bangladesh, and Thailand), until recently, almost 90% women in rural areas would attend antenatal clinics but only half or less of these women would choose to give birth at a health facility because they preferred cultural and traditional practices during delivery (Choudhury & Ahmed, 2011; Kyomuhendo, 2003; Lori & Bolye, 2011). Most of these women prefer home delivery attended by a TBA who is an experienced woman from the village. The preference for a TBA over a trained midwife is because of the former's familiarity with local customs and traditional practices, which are often criticised by trained professionals (Choudhry, 1997). These practices include use of herbs during childbirth to facilitate labour, cutting, and disposing the umbilical cord, and customs for postnatal care.

Again, there is secrecy surrounding pregnancy and childbirth in rural areas of developing countries. A common belief among women is that public knowledge of their pregnancy increases vulnerability to spirits, ancestors, and witchcraft. Rural communities fully

recognise complications associated with childbirth but, because of the secrecy and emphasis on endurance and tolerance of physical pain and other life-threatening symptoms, pregnant women are unwittingly taught to suppress concerns about conditions which require urgent medical attention; consequently they may not communicate with anyone until it is too late (Kyomuhendo, 2003). The cultural environment, to a great extent, limits their knowledge and choices. The women lack knowledge about reasons for pregnancy complications, appropriate management of the complications, and awareness of when to refer a woman to a health facility (Maimbolwa et al., 2003).

“Childbirth is an intimate and complex transaction whose topic is physiological and whose language is culture” (Jordan, 1982, p.182, as cited in Choudhry, 1997). Maternal mortality in developing countries is influenced by socio-cultural beliefs, including gender and power relations, and differences in roles and status between the sexes (Choudhry, 1997; Cole-Ceesay et al., 2010; Geçkil, Şahin, & Ege, 2009; Goodburn et al., 1995; Kyomuhendo, 2003; Lori & Bolye, 2011; Ogwuegbu & Eze, 2009; Selepe & Thomas, 2000; Wilkinson & Callister, 2010). The interventions in modern maternal care systems in developing countries are technically-based, with little attention paid to the women’s social background and the cultural contexts in which maternity care is provided (Goodburn et al., 1995; Maimbolwa et al., 2003). It is evident that, even in the 21st century, traditional childbirth practices and beliefs continue to exist alongside modern maternal care systems, pose as barriers to utilisation of maternal care services, are contributing factors to high MMR, and deny maternal autonomy (Kyomuhendo, 2003; Maimbolwa et al., 2003; Ogwuegbu & Eze, 2009). The approach and care provided by interventions dealing with childbearing women from various cultures can affect the quality of the experiences of these women. Understanding these cultural beliefs and traditions can aid the development of culturally congruent interventions aimed at reducing maternal mortality and morbidity (Lori & Bolye, 2011). An appreciation of cultural meanings sensitises the policy makers, implementers, healthcare professionals, and the community; this ensures provision of appropriate care to women in developing countries, and can ease their adaptation into modern healthcare systems and the use of technology such as eHealth and mHealth services.

2.3 Information and communication technology for development

Information and Communication Technology for Development (ICT4D) involves the use of ICT to support economic growth and enhancement of social services and institutions for socio-political transformation in developing countries (Avgerou, 2008). Literature on ICT4D commonly covers digital technologies that support the process of communication; or gathering, processing, and disseminating information (Kleine, 2013). Similar to development studies, the 'development' part in the ICT4D has been an area of major debate among theorists. Broadly, development refers to a process of socio-economic structural transformation of a country (Sumner & Tribe, 2008). However, international agencies and donors may view development as short to medium term outcomes of desirable targets measured against policy objectives and performance indicators i.e. reduced MMR (Sumner & Tribe, 2008).

Sen (1999) has defined development as a multidimensional concept focusing on opportunities or expansion of freedoms that people can gain. Sen's definition forms the basis of human development as adopted by the United Nations (UN). Human development refers to a process of enlarging people's choices and improving human capabilities and freedoms, so that they can live a long and healthy life, access education, have a decent standard of living, and participate in their community and the decisions that affect their lives (UNDP, 2010). The emphasis in human development is that more than the material gains that lead to economic growth, the primary benefits of development are well-being, empowerment, and justice; such kind of gains, Gomez and Pather (2011) term intangible but useful outcomes that support economic growth. Tengland (2008) asserts that empowerment is a means to development, since it involves enhancing the capacity of an individual or a group to make effective choices and translate these choices into desired actions and outcomes (Alsop & Heinsohn, 2005). One has to achieve empowerment before getting to development outcomes.

2.3.1 Evaluation of ICT4D programmes

Evaluation is a process of determining the merit, worthiness and value of an initiative. In social programmes such as ICT4D, evaluation refers to a scientific activity where social research methods are used to collect, analyse, interpret, and communicate information about their workings and effectiveness (Rossi & Lipsey, 2004). Effectiveness here may mean a programme's capability to achieve desired outcomes. For this study 'effectiveness' denotes the degree to which a social programme is capable of producing expected results. The evolution of ICT4D evaluations can best be understood using the ICT4D value chain (Heeks & Molla, 2009; Heeks, 2010), which constitutes four types of ICT4D assessments: readiness, availability, uptake, and impact. The ICT4D value chain shows a shift in focus from readiness to impact in the evaluation of ICT over time, as depicted in Figure 2-3.

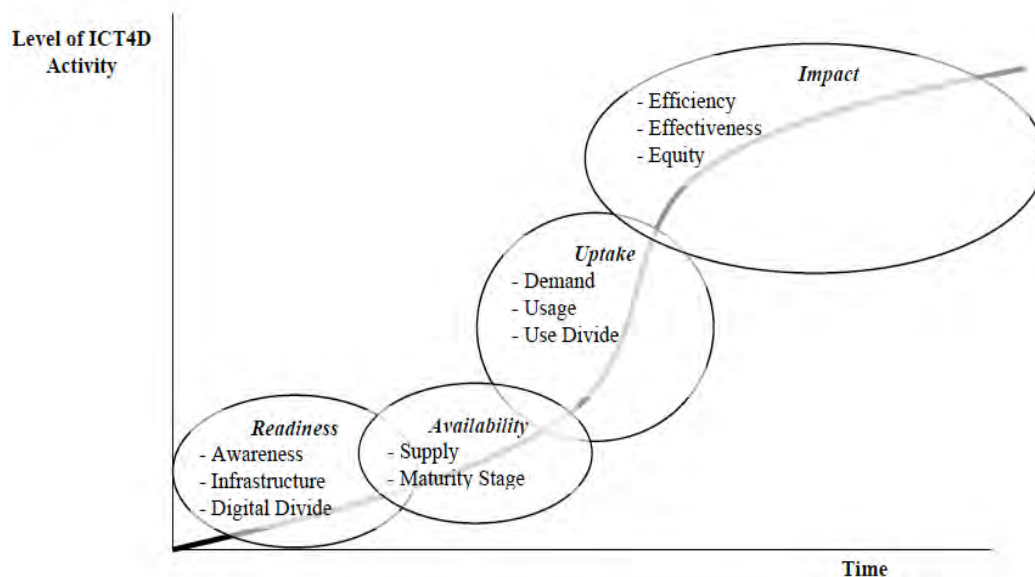


Figure 2-3: The ICT4D value chain
Source: Heeks & Molla (2009, p.4)

According to the ICT4D value chain, ICT initiatives are a result of inputs such as investments, stakeholders' support, and technology, among other things, in the planning stage that lead to implementation, followed by uptake of the innovation, and then benefit realization. The evaluation type involved at each stage respectively is as follows:

- i. *e-readiness assessment* of the prerequisites to ICT4D initiatives e.g. awareness, infrastructure and digital divide

- ii. *Availability assessment* which examines the presence and maturity level of ICT deliverables during implementation
- iii. *Uptake assessment* covering the how and why the ICT deliverables are being used by the targeted population
- iv. *Impact assessment* which measures the outputs, outcomes, and development impact of ICT4D initiatives to attest effectiveness, efficiency, and equity

Outputs evaluation focuses on immediate changes in behaviour due to technology use; examples of the changes can include new communication patterns or gaining knowledge that affects decision making (Heeks & Molla, 2009; Kivunike et al., 2013). The outputs lead to outcomes, which can be benefits and dis-benefits realised from technology use, for example improved health-seeking behaviour in mHealth interventions. Further, the outcomes impact development by contributing to the broader development goals i.e. reduced MMR in maternal health.

Evaluation of ICT4D interventions has evolved from measuring indicators that address the digital divide, based on lack or limited availability of technology to experiences and consequences of IS innovations (Avgerou, 2008). The assessment of experiences and outcomes of ICT4D initiatives focuses on developmental impacts that encompass socio-political and economic transformation (Gomez & Pather, 2012; Heffernan, Lin, & Thomson, 2012; Pather & Uys, 2010). The main reason is that infrastructural development measures cannot ascertain substantial impact of ICT on economic growth or even on digital divide, because digital divide does not only involve access to ICT, but also its use and the derived benefits from usage (Pather & Uys, 2010). The use of ICT in society, just as in organisations, produces both economic and social changes; this realisation in ICT4D resulted in a paradigm shift, where both social indicators and economic growth indicators are used to evaluate effectiveness (Gomez & Pather, 2012). Gomez and Pather (2012) further posit that understanding the effects of ICT on social outcomes makes the assessment of economic outcomes more meaningful, since intangible social indicators can sometimes show how change has been brought into people's lives.

Scholars have echoed concerns of difficulties in evaluating the impact of ICT4D because researchers use tools and techniques that are not suitable in the context of societal development (Gomez & Pather, 2012; Heeks, 2008; Heffernan et al., 2012). Furthermore, ICT4D research is fragmented, different academic disciplines work in silo, and it is not recognised as a multidisciplinary field (Heeks, 2008; Heffernan et al., 2012). The use of different frameworks and methods has resulted in ‘uncorroborated stories and hype’ which brought a lot of interest to developmental impact evaluation but does not yield satisfactory insights on apposite methods for evaluating the contribution of ICT towards socio-economic transformation of the marginalised (Heeks, 2008, p.27; Pather & Uys, 2010). In response to this challenge, Heeks and Molla (2009) developed a compendium of frameworks that could be used in ICT4D evaluation.

In research of diffusion and transfer of IS innovations from developed to developing countries, which falls within the readiness, availability, and uptake assessments, most studies use theories of diffusion of innovations (Rogers, 1995) and Technology Acceptance Model (TAM) (Davis, 1989). Social theories have proved to be more useful in assessing the social embeddedness of technology, hence the changes in organisational structure due to technology use, and how these influence adoption and appropriation (Avgerou, 2008). For impact analysis, some studies employ a cost-benefit analysis model, using well-defined indicators such as penetration, usage, and adoption rates, to evaluate economic growth in ICT4D (Aker & Mbiti, 2010); while those interested in socio-economic and political transformation of the marginalised engage theories for development. Capability approach (CA) has been found to be the most predominant framework used to evaluate socio-economic development, followed by sustainable livelihood framework (SLF) (Heffernan et al., 2012; Kivunike et al., 2013).

2.3.2 Development approach to ICT4D evaluation

In ICT4D, CA has been operationalised and applied in terms of possibilities or opportunities generated from the meaningful use of ICT for people to live a life they consider valuable (Gigler, 2004; Grunfeld, Hak, & Pin, 2011). The use of CA in ICT4D has shown that digital technology access alone is inadequate, and does not supersede issues of meaning. This

perspective regards meaningful use of ICT as an approach to expanding informational capabilities, which enhance human capabilities leading to improved well-being when realised into desired outcomes (Gigler, 2011; Zheng & Stahl, 2012). It is argued that people require a minimum set of capabilities to gain access to and make effective use of ICT, which in turn strengthens capabilities, contributes to empowerment, and supports the ability to sustain livelihoods (Grunfeld et al., 2011). Similarly SLF puts people and their pursuit of a livelihood at the centre of the development evaluation; it focuses on capabilities, assets, and activities as its core concepts (Chambers & Conway, 1992) .

To evaluate individual and community empowerment through ICT, Gigler (2004) integrated CA with SLF in an alternative framework for evaluating ICT impact. In this framework the transformation of capabilities, whether individual or collective, depends on the livelihood resources or capitals of people. Thus, expanding people's capabilities is relative to strengthening their capitals, including informational capital. Gigler (2006) argues that information is a fundamental input to many development activities. Aside from its power in enhancing capabilities such as literacy, information can also enhance marginalised people's capabilities to make strategic choices and achieve a way of life they value. Gigler (2006, 2011) further asserts that there is no direct and causal relationship between ICT and improved well-being. This relationship, rather, is shaped by dynamic, multi-dimensional inter-relationships between technology and social context. Thus, it bespeaks a developmental interdependency among people, social institutions, and technology. Consequently, for information and knowledge to play a role in improving wellbeing of the marginalised, they need to be fully integrated into the broader socio-political realities of communities.

Building on the use of SLF to operationalise CA, Kleine (2010) developed an evaluative tool for conceptualising the process of development in ICT4D. The main focus of her framework is individual freedom, where the prime aim and outcome of development is choice, which is followed by the intervention outcomes. She claims that the degree of empowerment for an individual is determined by the existence of different opportunities or options to achieving desired outcomes; an individual needs to be aware of the different options, and actually choose to utilise them to achieve a desired outcome. This process takes place in open

society where there are always dialectical interactions between agency and structure. The human capitals from SLF are conceptualised as asset endowments for agency to negotiate 'policies, institutions, and processes' in the opportunity structure. CA advocates for participatory methods for identification of outcomes for interventions, as they will account for local and cultural realities of the context and choices of individual to live a lifestyle they value.

This study adopts the development approach to evaluate MSSM intervention in maternal healthcare, using CA and critical realism approach with the aim to yield an understanding of how a social programme working produces diverse effects. The evaluation is done by developing a tested theory about what works for whom in what circumstances and why (McGrath, 2013; Smith & Seward, 2009). The focus on opportunities of an individual and context is vital for underlining the intangible benefits or impacts such as empowerment, self-esteem, and social cohesion, which are strategic development goals for social transformation and are necessary for economic growth (Gomez & Pather, 2012).

2.4 Empowerment as a process of development

Enormous literature exists on the use of ICT for development, but whether or not ICT contributes to development is still questionable, due to lack of or inadequate impact assessment of ICT4D projects (Gomez & Pather, 2012; Heeks, 2010). The question of debate is 'How do ICTs contribute to development?' (Heeks, 2010). The Capability perspective (Sen, 1999), which views development as freedom, provides an approach to evaluate how ICT empower people in their local context to progress their own visions of development. In practice, this approach engages participatory monitoring and evaluation where individuals and/or communities are involved in the planning, implementation, monitoring, and evaluation of development and programmes (Kleine, 2010). The primary outcomes of such an evaluation are choice and empowerment (Kleine, 2010; Kleine, 2013), where empowerment is both an outcome and a process that lead to development outcomes i.e. reduced maternal deaths in maternal health.

2.4.1 Defining empowerment

The term 'empowerment' means different things to different people; it denotes different goals and practices in various fields. However, most theories on empowerment share certain common characteristics such as power, empowerment being a goal or process, different levels of empowerment, and that people can empower themselves (Cattaneo & Chapman, 2010; Ellis-Stoll & Popkess-Vawter, 1998; Hur, 2006). Central to any model of empowerment is power. The consensus in literature is that, to be empowered, one has to be in a state of being disempowered, a disadvantage caused by the way in which power relations shape choices, opportunities, and well-being (Luttrell et al., 2009). This power can be seen as an influence in social relations – dyadic interactions as well as interactions between agency and opportunity structure. By means of this power, an individual has control over their life. Agency is defined as the ability to set and pursue one's own goals and interests, while structure refers to informal and formal context within which actors operate. People can empower themselves; development agencies do not empower people – they simply facilitate the process by providing resources and opportunities in making the environment feasible for empowerment (Mosedale, 2005; Rodwell, 1996).

2.4.2 Categories of empowerment

Empowerment can be either a goal or a process to achieving desired outcomes. As an outcome, empowerment can be enhanced or evaluated, and it has three general goals:

- i. Control of an individual's own health
- ii. Increase in the ability to control one's life
- iii. Increase in the ability to make a difference, changing the world

(Hur, 2006; Tengland, 2007; Tengland, 2008)

Empowerment as a process is dynamic and constantly evolving, unpredictable and changing over time and place (Hur, 2006). Having control over one's life is the best starting point of the empowerment process, as the other two goals can be encompassed in that one goal (Tengland, 2008). Having control over determinants of one's quality of life leads to improved

well-being. Furthermore, empowerment occurs at different levels of individual, group, community, and even nationwide.

2.4.3 Individual versus community empowerment

At the individual level, empowerment can be defined as enhancing an individual's capacity to make effective choices and translate these choices into desired actions and outcomes (Alsop & Heinsohn, 2005). An individual goes through a process of empowerment to achieve its outcomes; this means that, given resources and skills, a person takes control over the change process, determining the goals of the process and means to use them. In other words, a person has the freedom to set and pursue his/her goals and interests, thus exercising agency. The specific empowerment goals achieved at individual level could be knowledge, consciousness raising, skills development, autonomy, self-esteem, self-confidence, self-efficacy, ability and freedom. The process of empowerment emanates from individuals to promote community empowerment.

Community empowerment refers to a process through which oppressed groups gain greater control over their lives and environment, acquire valued resources and basic rights, and achieve important life goals and reduced societal marginalisation (Maton, 2008). Community empowerment is a participatory-developmental process which takes place over a period of time, involving active and sustained engagement, and resulting in growth in awareness and capacity (outcomes) (Maton, 2008). Community empowerment establishes community building, so that members feel a sense of freedom, belonging, and power that can lead to constructive social change and create structural alternative.

The potential for community empowerment exists in every environment, just as the potential for individual empowerment exists in every person. In every process of individual empowerment, there also exists a potential for community empowerment. Conversely, the process of community empowerment creates an environment that facilitates individual empowerment and at the same time also shapes and determines its form (Maton & Rappaport, 1984, as cited in Maton, 2008).

Hur (2006) discusses the process of empowerment in five progressive steps.

- Empowerment – starts with the existence of *individual disturbances and/or social disturbances*, which brings a sense of powerlessness; thus the oppressed and empowering agent discover the reality manifested as disadvantages, oppression, alienation, or stratification.
- *Conscientising* – people become aware of their limited power and the potential to change their circumstances.
- *Mobilisation* – follows the conscientising, where initiatives are taken into empowering the disadvantaged by asking them to join the movement that mobilises collective action for freedom.
- *Maximising* – power is shared in the process of mobilisation and action against disadvantages or oppression until it reaches its maximum; at this stage empowerment reaches the point that the people feel able to utilise their confidence, desires, and abilities to bring about ‘real change’.
- *Creating a new order* – when power has reached its maximum it creates a new social order.

Likewise, the World Bank asserts that four key elements that can change power relations in a society are access to information, inclusion and participation, social accountability, and local organisational capacity (Narayan-Parker, 2005).

2.4.4 Factors affecting empowerment

Empowerment is influenced by the opportunity structure, which either facilitates or constrains it. The opportunity structure is shaped by the presence and operation of formal and informal laws, regulations, norms, beliefs, values, and customs (Alsop & Heinsohn, 2005). These institutions determine whether individuals and groups have access to resources, and whether these people can use the resources to achieve desired outcomes. Opportunity structures affect the degree of empowerment, since they can enable or restrict choices and opportunities.

2.4.5 Women and empowerment

Women empowerment refers to women's ability to make decisions that affect events and circumstances around them, allowing them to:

1. Benefit from resources and opportunities
2. Exercise control over their own life, body, and resources
3. Have a say in public life and decision-making

All result in increasing or achieving autonomy and improving health and well-being (Huyer, 2006).

Empowerment in general is categorised into two forms, the political and socio-economic empowerment. Political empowerment for women consists of either individual or collective actions to promote women's rights in the civil and political context at community or household level, aiming to improve women's access to resources and status. Socio-economic empowerment involves actions aiming at improving the situation of an individual, with the focus on economic opportunities, including poverty reduction, improved livelihood, improvement of health, food security, and other basic needs, as a step to achieving strategic gender equality goals i.e. increased sense of agency or improved women status in the household or community (Hafkin & Huyer, 2006).

To ascertain that women empowerment has been achieved, Huyer (2006) claims that political and socio-economic empowerment should be assessed against the five targets below:

- Economic empowerment: participation and opportunity, including over income and family resources; increased income and access to employment; participation in the formal economy and work force at higher levels with higher pay
- Socio-cultural empowerment: freedom of movement, lack of discrimination, visibility in public places, and positive media images
- Personal empowerment: with respect to status and autonomy in the household and family; the right to make choices in one's personal life and in one's family; access to

reproductive health and family planning resources; access to sufficient nutrition and healthcare; safety, security, and integrity

- Psychological empowerment: self-esteem, self-efficacy, potential for mobilisation, sense of inclusion, and entitlement by self and others
- Education: access to literacy and education at all levels

2.4.6 ICT and women empowerment

To promote women empowerment, ICT needs to provide opportunities to gain options, choice, control, and power; or promote the ability to make decisions, based on useful information, that affect outcomes in a woman's life. Huyer (2006) argues that the role of ICT in supporting women's empowerment is measured by their ability to enable agency, capabilities, and choices for women and their role in supporting a process of change from a condition of disempowerment.

Literature has shown that the use of ICT, more so mobile phones, in developing countries has proved to be a vital mechanism for marginalised women to resolve their daily concerns in the socio-economic process to increase autonomy (Macueve et al., 2009; Shirazi, 2012). In Iran, the use of blog sites and mobile phones enhanced women's freedom of expression; they were able to protest against Islamic political ideologies and practices imposed on them, which would not have been possible with other media e.g. radio or television that is controlled by the government (Shirazi, 2012). Through the use of ICT, there was improvement in women's role and presence in society, as well as democratic participation, resulting in a revolution in the social, cultural, and political spheres of Iranian society (Shirazi, 2012).

The use of ICT has been found to shift perceptions about women's role and position in society as it promotes entrepreneurial activities among women, improving their business practices and breaking the traditional gender barriers at home and in the marketplace (Macueve et al., 2009; Malhotra, Kanesathasan, & Patel, 2012). Mobile phones, through sharing information and even informal learning, establish virtual communities that yield social capital such as trust and networks that women draw upon to solve their common

problems (Abraham, 2009). Some women use mobile phones to seek employment opportunities and to communicate with long-distance relatives, thus strengthening family links and support networks (Macueve et al., 2009). With the use of mobile phones, even the illiterate are learning minimal numeracy to recognise a contact number and dial it. These changes, brought about by ICT, do not benefit the women alone, but yield socio-economic benefits for family, community, and the country.

Women in developing countries prefer mobile phones to other ICT because of, among other factors, their mobility and ease of use. Mobile phones help women to save time as they eliminate travel, and can be used without abandoning the workplace or market place; in addition to multi-tasking and coordinating business with domestic responsibilities (Buskens & Webb, 2009; Malhotra et al., 2012). A study in Mozambique found that women would appropriate ICT if they responded to their needs. Mobile phones were the most used because in their developing country context they managed to strengthen their ability to solve problems (i.e. call a distant relative asking for financial help), make decisions and choices, and take desired actions (Macueve et al., 2009).

2.5 Mobile for development

Mobile for development (M4D) is a sphere of ICT4D. ICT4D started with the hype of Internet as a tool to bridge the digital divide between the developed and the developing countries. The hypothesis was that, through digital inclusion, developing countries and their communities would have access to information for competitive advantage in international markets that would result in economic growth. Due to low penetration of computers and Internet infrastructure in developing countries, the solution was found in planting telecentres where people could go and access the Internet. The business model of telecentres proved to be a failure due to reasons ranging from factors affecting design and implementation, to sustainability and scalability (Heeks, 2008). The next phase of applying ICT for Development, which Heeks (2008) called ICT4D 2.0, embroils the use of mobile phones, a technology that is readily available in most parts of developing countries.

Mobile technology is an extension of computing and the Internet into wireless medium, allowing users to have access to information and applications anytime and anywhere; hence providing flexibility in communication, collaboration, and information sharing (Kaplan, 2006; Sheng, Nah, & Siau, 2005). The mobile phone is the fastest growing technology worldwide with over 6 billion mobile cellular subscriptions, at 96% global penetration rate in 2013, and 89% penetration rate in the developing world (ITU, 2013). Mobile phones are becoming an important ICT tool even in remote and rural areas of developing countries; their ubiquitous power, rapid development of the technology, low cost, and ease of use qualify them as an appropriate and adaptable tool to bridge the digital divide, and for development (Blake, 2008).

2.5.1 Trend of mobile phone technology

Information technology offers innovative methodologies to overcome the range of access and resource barriers in healthcare specific to developing countries. Governments and development agencies in developing countries view mobile technology as a potential ICT tool for development and improving livelihoods. With a penetration rate of 89% in developing countries, as shown in Figure 2-4, many people already own mobile phone devices, serving as a basis for most mHealth initiatives (ITU, 2013).

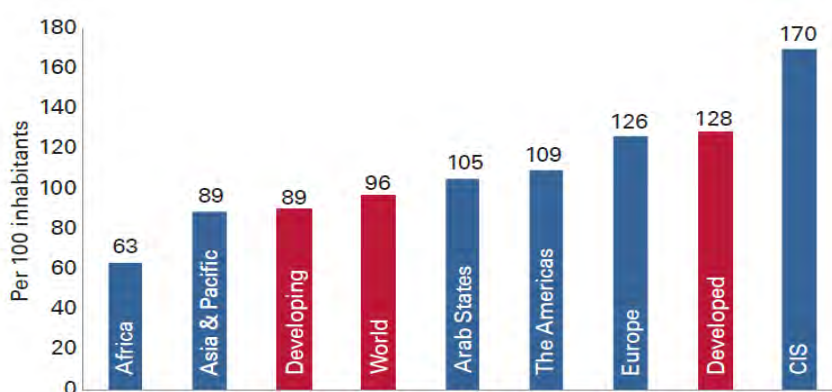


Figure 2-4: Mobile phone penetration rates, 2013
Source: ITU (2013)

Despite the substantial growth in the mobile telephony in the world since 2003, Africa still has the lowest penetration rate – 63% compared to the overall international rate of 96% (ITU, 2013). In Africa, the mobile phone penetration rate varies largely between countries.

In 2012, only a few countries in Sub-Saharan Africa had a penetration rate of more than 40%, with South Africa having the highest penetration rate of 65% (GSMA, 2013). Mobile phones are increasingly spreading in Africa because they are less expensive than the traditional landline and standard Internet. Even though mobile phone penetration is generally lower in Malawi than in many other African countries, the market is growing rapidly (Makoza & Chigona, 2012). Between 2007 and 2008, mobile phone subscription in Malawi had risen from 7.3 to 12.0 per 100 people, representing an increase of 64%; this has further increased from 12 in 2008 to 24 per 100 people in 2011 (ITU, 2011b).

2.5.2 Benefits of mobile phone technology in developing countries

Mobile phones have become an integral part of everyday life, and the technology is gaining importance and popularity in the developing world, as they are less expensive than the traditional fixed landlines or standard Internet (Heeks, 2008). The phenomenal uptake of mobile phone technology in the developing world shows that it has struck a chord in the community in a way that other technologies might not have (Butt & Phillips, 2008). In addition, it has had great impact, not only on the communication demeanour, but also on culture, community, identity, and relationships (Butt & Phillips, 2008).

Its utilisation is growing at a rapid rate, not just for interpersonal communication but also as an important aspect of communication infrastructure for development in sectors like finance, education, agriculture, and marketing where there is mobile banking, mobile learning, mobile agriculture, and mobile commerce (Duncombe, 2011). These new innovations of value-added services deliver substantial development benefits both to the providers and clients i.e. employment and business opportunities (Duncombe, 2011). In addition, they have improved performance of state institutions through delivery of healthcare and education services, and promotion of democratic participation (Avgerou, 2008). Mobile phones are being used as a mechanism for saving and making money in low-income communities, both at individual and community level.

2.5.3 Challenges of mobile technology in developing countries

Mobile phones have, however, come with some challenges in developing countries, e.g. high costs of maintaining a mobile phone i.e. expensive talk time (Han, 2012; Porter et al., 2012). This problem may represent an excess of cost over economic benefits (Gomez & Pather, 2012), and taking the little money developing countries make to the global north, which could have been used to alleviate prominent issues of extreme poverty, diseases, and illiteracy. A mobile phone, being an object of desire and prestige, puts those people who own them at risk of being victims of violent crime (Han, 2012; Porter et al., 2012). Further, it promotes negative behaviour where young girls are involved in prostitution in order to own or maintain a phone (which is also spreading HIV/AIDS), while youngsters find a mobile phone an easy target to steal and sell to find money for drug abuse (Han, 2012).

Mobile phones also increase surveillance on youth and women, affecting power relations that can lead to gender and social inequalities (Porter et al., 2012; Sinha, 2005). In addition, mobile phones are open to public access in developing countries due to the culture of sharing; there are also issues of security and privacy, especially with health information (Aranda-Jan et al., 2014; Mechael et al., 2010). Overall, the evaluation of M4D initiatives has shown that mobile technology has the potential to expand people's capabilities and facilitate development (Aranda-Jan et al., 2014; Duncombe, 2011). Mobile phones also contribute towards socio-economic development in developing countries through delivery of healthcare services (Avgerou, 2008; Chib et al., 2014; Mechael et al., 2010).

2.6 mHealth in developing countries

mHealth is the use of mobile communication devices, such as mobile phones, to deliver health services and information (Noordam et al., 2011). Text messaging, video messaging, voice calling, cameras, automated sensing, and Internet are some of the mobile technologies that have been utilised in mHealth to improve access and quality of information and services (Banerjee & Hsi-Shi Leong, 2006; Klasnja & Pratt, 2012). Social networking tools e.g. Twitter and Facebook can enable new applications that use mobile phones to seek and share advice, expertise, support, and local resources for health

management. These applications and many others have the potential to make a major contribution towards health promotion and healthcare delivery through the communication of health messages aimed at the modification of lifestyle behaviours, and in the monitoring of patient health data. Mobile technology interventions have been used for chronic disease monitoring and tracking; treatment and therapy adherence; medical test result delivery; patient-provider communication; health information communication; remote diagnosis; data collection; disease and emergency tracking; and access to health records; both in developed and developing countries (Cole-Lewis & Kershaw, 2010; Klasnja & Pratt, 2012).

In developing countries, the use of mobile technology as a healthcare intervention has tremendous, but as yet untapped, potential. This may be due to technical as well as socio-economic, cultural, and regulatory barriers (Kaplan, 2006). There are mixed opinions on the success, cost benefit, and practicality of mHealth interventions. There is as yet no study-based evidence, from long term or fully blown rolled-out projects, on whether they effectively improve health services and health outcomes in developing countries. Hence calls in literature for further exploration and analysis of the impact of mHealth intervention on the healthcare system or among consumers at institutional and individual level (Aranda-Jan et al., 2014; Chib et al., 2014; Mechael et al., 2010).

2.6.1 Application of mHealth in developing countries

The commonly used mobile phone application in developing countries for mHealth is short message service (SMS), since it is readily available even in basic phones, and proves to be affordable and convenient, compared with other applications (Cole-Lewis & Kershaw, 2010). The push technology in SMS allows intervention messages to be delivered without effort on the part of the recipient. Furthermore, the ability to utilise both mobile phones and computers, coupled with automatic processing of SMS, maximises interactions in interventions (Klasnja & Pratt, 2012). Recently, the use of multimedia and mobile phone games for behaviour change communication in sensitive issues of reproductive health and communicable diseases is proving to be effective in creating awareness and increasing knowledge (Free et al., 2013; Khanna et al., 2012; Treatman & Lesh, 2012). This combination of education and entertainment is called edutainment, referring to the process of purposely

designing and implementing a media to both entertain and educate, to increase audience knowledge about an educational issue, create favourable attitudes, shift social norms, and change overt behaviour (Singhal & Rogers, 2002). Table 2-1 summarises some mobile phone features used in the application of mHealth in developing countries.

Table 2-1: A few sampled studies on mobile phone features used in mHealth in developing countries

Phone features	Focus	Application area	Studies
Text messaging	Dissemination of health information	Education/Awareness	Chib et al. (2012); Datta, Ranganathan, and Sivakumar (2014); De Tolly, Technau, and Benjamin (2012); Huq et al. (2012)
	Reminders	Clinic appointments Treatment adherence	Crawford et al. (2014); Lund et al. (2014a); Oyeyemi and Wynn (2014); Batra et al. (2012); De Tolly et al. (2009)
	Fast communication & information sharing with CHWs	Service delivery Monitoring and Data management	Lemay et al. (2012); Mahmud, Rodriguez, and Nesbit (2010); Munro et al (2014)
Voice call	Consultations, emergencies, remote patient monitoring, and management	Service delivery	Crawford et al. (2014); Huq et al. (2012)
Camera (Video and photos)	Remote diagnosis	Service delivery	Power, Dillon, and Cleary (2010)
Games and Multimedia	Edutainment – for behaviour change	Education/Awareness	Khanna et al. (2012); Treatman and Lesh (2012)
Mobile Internet	Information sharing	Education/Awareness Data management	Chib, (2010); Lim et al., (2011)
Other applications	Data collection, data entry, and patient management	Service delivery Data management	Boulos, Wheeler, Tavares, and Jones, (2011); Vélez, Okyere, Kanter, and Bakken (2014)

mHealth applications are many and diverse, ranging from information dissemination, appointment reminders, remote data collection, diagnostic treatment and support, disease outbreak surveillance, drug adherence, and remote monitoring (Crawford et al., 2014; Munro et al., 2014; Power, Dillon & Clearly, 2010). The pervasiveness of mobile phones is also used to spread health information for education and awareness (Chib et al., 2012; Huq et al., 2012). SMSs are commonly used for this purpose in developing countries since they are a cost effective, efficient, and scalable method of providing outreach services on a wide array of health issues and can be set directly to users' phones to offer information about testing and treatment methods, availability of health services, and disease outbreaks (Cole-Lewis & Kershaw, 2010). The mass communication through SMS alerts is effective in targeting hard-to-reach populations, especially in rural areas where absence of clinics, lack of healthcare workers, and limited access to health-related information prevents people

from making informed decisions about their health (De Tolly et al., 2012; Ramesh et al., 2008). Some health consumers seek health information from the Internet using mobile Internet (Lim et al., 2011).

Mobile phones are also used by Community Health Workers (CHWs) to collect data from the field. This has shown to improve typology mistakes and provide up-to-date information in a short period for decision-making, hence improving efficiency (DeRenzi et al., 2011; Lemay et al., 2012). In primary healthcare, interventions for remote diagnosis and treatment, treatment adherence, and patient data collection by health workers at the clinics enhance efficiency and cost reduction in service delivery, while saving more lives in rural areas for those with limited access to healthcare (Batra et al., 2012; Boulos et al., 2011). Doctors in main hospitals can remotely diagnose and provide treatment to patients in rural areas who need specialist attention. Remote monitoring, awareness campaigns in health promotion, and even patient self-management interventions have resulted in well-timed dissemination of health information, which have improved the ability to diagnose, treat, and track diseases, and provide more actionable public health information (Huq et al., 2012; Huq, Azmi, Quaiyum, & Hossain, 2014; Lund et al., 2014a).

2.6.2 Benefits of mHealth in developing countries

The advent of mobile phones has the potential to enhance healthcare delivery and promotion of health, especially due to their personal nature, as put by Klasnja and Pratt (2012):

The personal nature of mobile phones can reduce the barriers to adoption and increase acceptance of phone-based health interventions by integrating health education and other forms of health promotion with a tool that is an integral part of individuals' daily routines and to which they often have positive emotional attachment (Klasnja & Pratt, 2012, p.185).

The pilot projects on mobile phone-based interventions in developing countries have shown positive results among persons of low socio-economic status and ethnic minority in

improving health outcomes and process of care delivery (Blake, 2008; Krishna et al., 2009; Lim et al., 2011; Tezcan et al., 2011).

The benefits of mHealth in health systems of resource-constrained developing countries include increased access to healthcare and health-related information, especially to the hard-to-reach population (Blake, 2008; Krishna et al., 2009; Tezcan et al., 2011). mHealth has also increased efficiency and cost reduction in service delivery and dissemination of actionable public health information, which sequentially leads to early detection of ailments, enhanced diagnosis, adequate treatment, and proper tracking of diseases (Chib et al., 2008; De Tolly et al., 2012; Lim et al., 2011). In addition, it has enhanced communication among health workers, especially with those in rural areas; as well as the provision/expansion of training and medical education for health workers (Aranda-Jan et al., 2014; Mechael et al., 2010).

Since mobile phones are cost-effective, wide-reaching in application, target large samples and access hard-to-reach groups, they have the potential to support patient self-management, health decision making, and patient education (Chan & Kaufman, 2010; Klasnja & Pratt, 2012). This leads to increased consumer-provider access to relevant health information, enhanced quality of care, reduced healthcare errors, increased collaborations, and encouragement of adoption of health behaviours (Kreps & Neuhauser, 2010), which in the end contribute to overall health outcomes. Mobile phones have played an important role in improving the provisional transfer of patient records and also enhancing appointment booking system using SMS reminders; these improved processes contribute to lower numbers of failed appointments, quicker diagnosis and treatment, and improved teaching and training (Krishna et al., 2009). Although mobile technology has had an immense impact on the economic and social life in developing countries, the potential benefits in healthcare have not been sufficiently investigated, and the development and implementations of mHealth interventions have been poor (Abimbola, 2011; Kreps & Neuhauser, 2010).

2.6.3 Challenges in implementation of mHealth in developing countries

The design, implementation, and adoption of mHealth in developing countries are beset with a wide range of challenges. To start with, most of the technology applications used in most electronic health (e-health) interventions are not designed in the developing countries; rather, they are imported from developed countries (Chan & Kaufman, 2010). Consequently, most of these applications are not aligned with the realities of rural settings of developing countries. Even though health challenges faced by the health system are global, solutions need to be local, taking into account realities of the settings, to effectively serve the needs of the consumers/patients. As such, most mHealth interventions in developing countries are not maximising the full benefits mobile technology communication could have on health outcomes. The design and implementation of such interventions need to take into consideration local realities of settings, encompassing political, social, cultural, technical, and economic factors, under which the intervention would work best (Abimbola, 2011; Chan & Kaufman, 2010).

Chan and Kaufman (2010) identify a number of challenges in design and implementation of mHealth interventions, including limited healthcare resources, medical expertise, access to healthcare, access to technology, infrastructure, and technical expertise to support technology. Further challenges and barriers identified relate to mismatches among health interventions, technology, and target population; where meaningful access, use patterns, usability, appropriate interactions, and design considerations usually affect the consumers. It is essential to design health intervention tools that communicate effectively with a diverse array of healthcare consumers, providers, and policy makers, taking into account that communication is a central social process that demands strategic design, careful monitoring, and responsive adaptation (Kreps & Neuhauser, 2010). Further, the use of technical expertise from developed countries for development and maintenance of mHealth systems affects sustainability and scalability, as it turns out to be expensive for large scale deployments (Aranda-Jan et al., 2014; Ngabo et al., 2012).

Technological challenges range from security, confidentiality, to interoperability of mHealth systems. Most mHealth projects were found to be working independently, not integrated

into the health systems (Aranda-Jan et al., 2014; Tamrat & Kachnowski, 2012). mHealth systems need to be integrated into existing health systems for easy communication and operations (Mechael et al., 2010). Access to technology and relative ease-of-use influence the uptake of mHealth interventions; however lack of skills to use the technology is usually a barrier, especially in remote areas (Aranda-Jan et al., 2014, p.11).The mobile network connectivity in most rural areas of developing countries provides weak signals which makes it harder to use the phone; however, the coverage is increasingly expanding (Chigona, Nyemba-Mudenda, & Metfula, 2012). Further, electricity utility is limited to a small percentage of urban population in most developing countries, thus mobile phones in rural areas are rarely found with power (Little et al., 2013; Ngabo et al., 2012). Illiteracy also poses as a challenge in mHealth utilisation in developing countries; inputting, displaying, transferring, and processing of data is a problem for people with low levels of literacy (Pundir, Sharma, Shukla, & Khurana, 2012). Lastly and most importantly, the challenge in showing evidence of the cost-effectiveness of mHealth interventions affects sustainability and scalability; policy makers are in doubt about investing in mHealth since the claimed benefits are unclear and long-term results are indeterminate (Aranda-Jan et al., 2014; Mechael et al., 2010).

2.7 mHealth for maternal healthcare in developing countries²

This section is an abridged version of a conference paper. The section discusses what is known so far about mHealth in maternal health in developing countries. The methodology used to gather and analyse the papers is presented in a full paper provided in Appendix F.

mHealth in maternal health is still burgeoning. All the studies reviewed focused on pilot projects, with the exception of one project from Rwanda, Africa that had a nationwide deployment (Ngabo et al., 2012). The use of mHealth in maternal healthcare in most developing countries involves innovative ways to reduce the delay in recognising the need

² This section is part of a conference paper published in the Proceedings of the 13th International Conference on Social Implications of Computers in Developing Countries, Negombo, Sri Lanka, May 2015. Nyemba-Mudenda & Chigona (2015); mHealth drivers for maternal health outcomes in developing countries: A systematic review.

for medical intervention, reaching point of care, and receiving timely adequate care. Current mHealth projects aim at increasing access to maternal healthcare services and increasing health facility utilisation. Despite a myriad of challenges (recall Section 2.6.3), mHealth use in maternal health has the potential to improve health outcomes for the mothers, communication among health workers, and data management in health facilities. Two systematic reviews on mHealth in maternal health, Noordam et al. (2011) and Tamrat and Kachnowski (2012), have shown that mobile phone technology is basically used for:

- Demand generation for maternal healthcare services through health promotion and education
- Emergency obstetric referral, helping women access medical intervention on time
- Improving capacity of remote health workers through provision of point of care support, by connecting health personnel at different level facilities to transfer knowledge and share best practices
- Data collection and management, i.e. reporting and performance appraisal

2.7.1 Factors influencing mHealth use in maternal health

Literature has shown that five key factors contribute towards mHealth outcomes realised in maternal health in developing countries. As shown in Table 1 of Appendix F, the factors include: (i) Accessibility to mobile communication; (ii) System usability and adaptation; (iii) Service convenience; (iv) Health institution resources; and (v) System integration.

2.7.1.1 Accessibility to mobile communication

An initial step to mHealth is access to mobile phones. Despite the hype of increasing mobile phone penetration rates in developing countries, mobile phone ownership is still low, especially in remote areas (James & Versteeg, 2007; James, 2011). In a number of studies it was found that less than 50% of people in the local communities owned mobile phones. Most of these phones are owned by men or elders of the family. The unequal distribution of phones is mainly due to the high cost of telecommunications, and socio-cultural discrepancies that disadvantage women in developing countries, e.g. the low position of women in society (Huq et al., 2012; Lund et al., 2014b; MacLeod et al., 2012; Osborn, 2013).

Thus, accessibility to a mobile phone for most women rely on sharing, which comes with a number of challenges such as messages not reaching intended audience; resulting in high dropout rates of project participants (Crawford et al., 2014; Lau et al., 2014).

Infrastructural barriers such as poor mobile network coverage and limited electricity access in remote areas have adverse effects on mobile communication accessibility. SMS messages are often not delivered and calls dropped due to poor network, especially in remote areas. In addition, mobile phones are switched off or usually out of power due to limited electricity for charging (Crawford et al., 2014; Huq et al., 2014; MacLeod et al., 2012; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014).

Cost of communication also affects mHealth adoption as a technology. Free services were found enabling for the women and the health workers when using the interventions, because most people in the rural areas of developing countries, especially women, cannot afford the costs associated with mobile phone use, due to their low socio-economic status (Huq et al., 2014; Lund et al., 2014a; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014). Incentives for community stakeholders including the health workers can foster community participation in mHealth interventions that could lead to project success. Receiving free mobile phones boosted community health workers' (CHWs) and other health personnel engagement in the mHealth programmes; and CHWs perceived calling health facilities from communities as empowerment, especially when they call for an ambulance or get any help that save women's lives (Andreatta et al., 2011; Chib et al., 2008; Huq et al., 2014; Little et al., 2013; Ngabo et al., 2012; Ramachandran et al., 2010; Vélez et al., 2014; Watson & Sabumei, 2014). Little et al. (2013) asserted that a sense of mobile phone ownership and empowerment act as a strong motivator for mobile phone use among health workers and, consequently, facilitate acceptability and accessibility of mHealth services.

2.7.1.2 System usability and adaptation

Mobile technology systems that adapt to local realities of communities in developing countries, along with ease of use, enhance mHealth acceptance and appropriation. Adaptation to local realities is one of the critical success factors for mHealth in maternal

health, especially if it mitigates barriers of language, illiteracy, and culture – resulting in appropriation of mHealth services (Huq et al., 2014; Lund et al., 2014a; MacLeod et al., 2012). Easy of use of mobile phones also encourage women to use mHealth services. Most women as mHealth beneficiaries are familiar with a mobile phone; however, that does not translate to having knowledge of how to operate the devices. In a number of studies, participants needed to be shown how to operate a mobile phone at the beginning of the project, including health workers in some cases (Andreatta et al., 2011; Little et al., 2013; Munro et al., 2014; Ngabo et al., 2012; Vélez et al., 2014). However after training, most mHealth project participants would find mobile phones easy to use.

2.7.1.3 Service convenience

mHealth services avail health information and services to the women in maternal health anytime and anywhere; facilitate contact with health workers; reduce healthcare costs; reduce time response in emergencies; and reduce the workload of health workers in data management and reporting. Service convenience was hypothesised to impact patient satisfaction and healthcare utilisation for the mothers, by making it easier to acquire services (Cole-Ceesay et al., 2010; Lund et al., 2012; Oyeyemi & Wynn, 2014). It also impacts health service delivery by making it easier for health workers to report, organise, and manage data for decision making, planning, monitoring, and evaluation purposes (Chib, 2010; Jareethum et al., 2008; Little et al., 2013; Watson & Sabumei, 2014).

Saving financial resources associated with transportation to a health facility by accessing health services from home is one of the advantages of mHealth (Huq et al., 2014; Lund et al., 2014a). mHealth services also increase contact with health workers, as women interact with them frequently from home. The frequent interaction with health workers boosts women's confidence to go to the clinic, especially in Africa where negative attitudes of health workers is one of the barriers to women accessing healthcare (Lund et al., 2012). Confidentiality is another perceived advantage associated with talking to health workers on the phone. Huq et al. (2012) found that the women were comfortable talking to someone they did not know and could not see, about sensitive problems they would rather not share in a face-to-face conversation. Furthermore, in a study in Papua Guinea, mobile phone

communication was found to be private and confidential when discussing cases among health workers, compared to using high frequency radio systems (Watson & Sabumei, 2014).

Another advantage noted in literature is that the referrals to a health facility reduce time response to emergency cases, especially where the mobile phone system is linked to transport services of the health system (Cole-Ceesay et al., 2010; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014). Applications for data collection are associated with reduced workload for health workers, since they improve on the paper-based system if properly integrated in the health information system (Chib, 2010; Little et al., 2013; Ngabo et al., 2012; Vélez et al., 2014); which also enhance data management and real time reporting.

2.7.1.4 Health institution resources

ICT such as mobile technology can enhance communication and processes for timely service delivery. However, community health programmes, complementary health facility resources, and infrastructure play a role in improving health outcomes. Poor health systems and infrastructure have adverse effects on the efficacy of mHealth in developing countries, and this was found to compromise health outcomes (Ngabo et al., 2012; Noordam et al., 2011; Tamrat & Kachnowski, 2012). Shortage of skilled health workers, lack of diagnosis and treatment resources, and poor logistics for emergency transport can adversely affect the efficacy of mHealth intervention (Cole-Ceesay et al., 2010; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014).

2.7.1.5 System integration

Most projects in the reviewed studies had integrated the mHealth intervention into the health system by either incorporating the mHealth system into an existing health information system (HIS), whether electronic or paper-based; or by the involvement of health workers in mHealth projects. Other projects worked in isolation without involving the health workers or incorporating the mHealth component into the existing HIS (e.g. Crawford et al., 2014; Lau et al., 2014). Integration at HIS level and/or involvement of health workers show potential in realising maximum benefits from mHealth, especially where there is

already an organised health system since mHealth interventions are there to enhance the processes of an existing system (Alam et al., 2010; Little et al., 2013; Ngabo et al., 2012; Vélez et al., 2014). System integration enhances engagement of health personnel in different levels of the health system; it further improves the skills of remote health workers, as it affords them an opportunity to learn from workers in higher levels, e.g., in hospitals (Chib, 2010; Little et al., 2013; Vélez et al., 2014; Watson & Sabumei, 2014).

2.8 Summary of the chapter

Maternal healthcare in developing countries is burdened with a myriad of challenges, resulting in delay in decision making to seek healthcare, getting to a health facility, and receiving appropriate treatment. The challenges have been attributed to poor access to health information to aid informed decision making; poor access to healthcare services due to long distances to a health facility; aggravated by poor transportation systems and cost of transport; in addition to poor infrastructure and limited resources at health facilities. The use of ICT, mobile phones in particular, has potential to improve health outcomes, health seeking behaviour, data collection and management. Success factors of such interventions include: accessibility to mobile communication; system usability and adaptation; service convenience; health institution resources; and system integration.

Despite the promises and benefits that come with using mobile devices for healthcare delivery and health promotion, evidence is yet to be conclusively established on the acceptance and feasibility of this technology for large scale deployment. mHealth is still in its infancy; published evidence is limited to literature on the application of mobile technology in healthcare delivery and benefits that lack clear substantiation. There is need for more research to evaluate social and cost effectiveness of the mobile phone interventions, and assess their impact on health knowledge, health outcomes and health delivery. In addition, investigating whether using the technology empowers people with information, communication, and interactive service to take care of their health and improve their wellbeing, which is in line with the objectives of this study, is necessary.

In coherence with the review in this chapter, the thesis seeks to analyse the mechanisms through which mHealth outcomes for maternal health consumers are derived in a developing country context. The thesis engaged critical realism and capability approach as a philosophical paradigm and theoretical model respectively, to guide the study.

The next chapter addresses these theoretical approaches.

3 CONCEPTUAL APPROACH

3.1 Introduction

The previous chapter discussed maternal health, ICT4D, and the use of mobile technology in health. This chapter presents the conceptual approach guiding the inquiry. The study adopted critical realism as a paradigm from which Amartya Sen's Capability Approach (CA) (1999) is enacted, to explain the effects of a mobile phone-supported health intervention on maternal healthcare consumers in the developing country context of Malawi. Since maternal health is a sensitive domain in the region, where social inequality affects a pregnant woman's autonomy and choices in health matters and overall quality of life (Lori & Bolye, 2011; Seljeskog, Sundby, & Chimango, 2007), CA was deemed an optimal framework to conceptualise and understand why the women use the mHealth intervention, the processes involved to achieving the outcomes in their particular context, and the actualised outcomes.

In the last decade some studies have shown that CA framework is compatible with the assumptions of critical realism and its explanatory power can illuminate why and how events were produced in a particular context (Martins, 2006; 2011; McGrath, 2013; Smith & Seward, 2009). This study is an attempt to use CA as an explanatory theory of mHealth outcomes for maternal health consumers in developing countries, with the focus on why and how the outcomes are produced, for whom, and in what circumstances. To the researcher's knowledge, this is the first study to use CA and critical realism in the ICT4D research domain.

The chapter starts with a discussion on critical realism, and then on CA. It further gives a justification on how the two are compatible, and why the study chose to use CA as an explanatory framework for mHealth use in maternal health in a developing country context. A criterion for selecting relevant capabilities is presented. This is followed by a review of literature on studies that have used CA in ICT4D research. Finally critiques and limitations of CA are presented, followed by the summary of the chapter.

3.2 Critical realism paradigm

Every theory of knowledge logically presupposes a theory of what reality is like, ontology, for knowledge, epistemology, to be possible. Critical realism espouses the notion that reality has an objective existence, independent of human consciousness, but human knowledge of this reality is conceptually mediated; thus, critical realism recognises the reality of the natural order and the events and discourses of the social world (Carlsson, 2012). Bhaskar (1998) asserts that the social world can only be understood and change facilitated if we identify the structures at work that generate those events and discourses. Many scholars even in IS (Carlsson, 2012; McGrath, 2013; Mingers, 2004b; Smith, 2006) regard critical realism as an alternative to positivism and interpretivism, with the aim of re-establishing a realist view of being in the ontological domain while accepting relativism of knowledge as socially and historically conditioned in the epistemological domain (Mingers, 2004b). In IS, being an applied field oriented towards the application of information systems in social settings such as business organisations and communities, critical realism has gained popularity in the past decade (e.g. Carlsson, 2012; Dobson, Myles, & Jackson, 2007; Smith, 2006; Wikgren, 2005).

3.2.1 The ontology of critical realism

Critical realism departs from the point that reality is differentiated, stratified and ever-changing. According to Bhaskar (1979), reality is differentiated between intransitive and transitive dimensions.

- a. The *intransitive dimension* constitutes entities that exist independent of our experiences of them. These are real objects of science such as physical processes or social phenomena i.e mHealth.
- b. The theories and discourses that are transformed into knowledge of this reality are part of the *transitive dimension* that indirectly connects science with reality.

In critical realism, real objects (natural or social) are subject to value-laden observations and interpretations, but these two operate in two different dimensions. The former is in the intransitive domain which is relatively enduring; and the latter functions in the ever-

changing transitive domain (Dobson, 2001b). The intransitive domain constitutes different kinds of entities such as physical entities, ideas and concepts, feelings and reasons, languages, meanings, norms, practices, and social structures, with differing ontological properties, and thereby entailing diverse epistemological possibilities.

As shown in Figure 3-1, the stratified reality, as explained by Bhaskar (1979), has three ontological layers namely: the real (what exists); actual (events); and empirical (observable events).

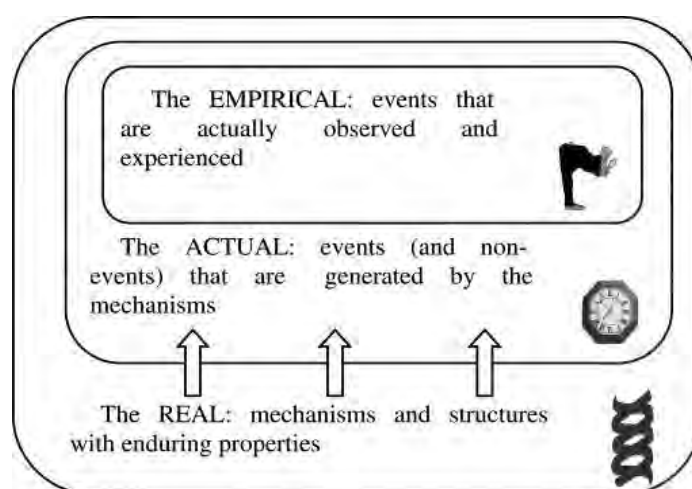


Figure 3-1: The three domains of real
Source: Mingers, 2004b

The *real domain* is the realm of whatever exists, natural or social objects consisting of structures which possess certain powers, potentials, and capacities designated in causal laws e.g a health system or a mobile phone in the case of mHealth. These structures in the real domain are capable of producing events, but they exist independent of the events they produce. The structures are underlying conditions of possibility that facilitate the occurrence of a given phenomenon; comprising of power that may or may not be exercised and, when exercised, may or may not be actualised in actual events (Martins, 2006). For instance, the structures of a health system though meant for improving people’s health; may or may not improve ones health depending on circumstances i.e. lack of resources at a health facility. The mode of operation of structures that emerge from its internal relations is referred to as mechanisms, which exist as the power that a structure possesses to behave or act in certain ways. As such, the causal mechanisms do not act deterministically (Sayer,

2000), but enable structures to behave in a particular way (tendencies) by virtue of its being, or internally related objects (Smith & Seward, 2009). Causal mechanisms could be internal workings of a technology system such as system affordances that give it powers to change an organisation or social setting. For example, the immediacy that mobile phones afford in accessing information can help improve the wellbeing of mothers by availing health information to them right in the community. The interactions among the mechanisms that create or produce something new, this is referred to as emergence (Bhaskar, 1998; Danermark, Ekström, Jakobsen, & Karlsson, 2002). The structures and their causal mechanisms exist in the intransitive dimension, which is irreducible to events and their patterns (observable or not) when causal powers are activated. These events and their behaviour are manifested in the *actual domain*, which can be observed or not and exist independently of human experiences.

The *empirical domain* consists of what we can observe. It is the domain of experienced events, our perception and impression of them. We may be able to observe some events but others are not observable. Thus observability gives us confidence of what exists but existence does not depend on it. Critical realists do not rely upon observations only but causal criteria too; thus, based on observed phenomena, the task is to understand the underlying mechanisms and how their interactions shape outcomes (Danermark et al., 2002). This ontological stratification decouples the structures and their generative mechanisms from the events that they produce, thus powers may exist without being exercised, and hence what is known to have happened does not exhaust what could happen or has happened. The nature of a real object at a given time enables or restricts what can happen, but does not pre-determine what will happen; context determines how mechanisms manifest in the empirical domain. This ontology makes it possible to understand how we could be or become many things at the same time i.e. the ignorant could become knowledgeable (Mingers, 2004b; Sayer, 2000).

3.2.2 Critical realism and epistemology

The main epistemological assumptions of critical realism are that science deals with a reality independent of science itself, which has the transitive and the intransitive dimensions. The

reality on this view consists of more than the actual course of events and experiences and discourses about them, and science seeks to identify and illuminate the structures, powers, and tendencies that structure the course of events (Patomäki & Wight, 2000). Since the intransitive dimension of reality is not immediately given in experiences and observations, then the transitive dimension is necessary in order to make sense of knowledge production (Mingers, 2004a). Patomäki and Wight (2000) argue that the transitive objects are a result of transformation of pre-existing knowledge, a set of antecedent materials such as theories, paradigms, models, facts, speculations, linguistic conventions, beliefs, hunches, hypotheses, guesses, and symbolic gestures. Furthermore, knowledge is a social product produced by means of antecedent social products on the basis of a continual engagement or interaction with its intransitive object; thus different theories can interpret the same, unchanging world in radically different ways (Patomäki & Wight, 2000). For instance, high MMR in developing countries is attributed to poor access to health information and services in some cases, and gender inequalities in other cases (Lori & Bolye, 2011; Noordam et al., 2011).

The theories and discourses that are transformed into knowledge of the reality (transitive domain) are historically emergent, political, and incomplete; which implies that they are fallible (Mingers, 2004b; Smith, 2006). Critical realism acknowledges that all knowledge is susceptible to fallibility, but continues to argue that not all knowledges are equally fallible; thus “Some researchers may have more valid explanations or theories that approximate the intransitive domain with more probabilistic accuracy than others” (Zachariadis, Scott, & Barrett, 2013, p.857). Failure to differentiate between transitive and intransitive dimension can lead to epistemic fallacy, that is, the conflation of statements about *being* in terms of statements about *knowledge* i.e. to believe that “What we think is all what is” (Wikgren, 2005). The stratification in critical realism implies that there is always an ontological gap that exists, since there is no direct relation between science and its intransitive object, but that this relationship is conceptually mediated by theories, transitive objects of science.

3.2.3 Social theory of critical realism

Social reality is different from the natural reality in the sense that society is an open system and is always affected by human actions. Society is morphogenetic, it has the capacity to

change its form and shape; its state at any given time depends upon human actions and their consequences (Archer, 1995). Society is constituted of two phenomena, agents and social structures; and their interactions. Critical realism identifies the *agent to agent* and *agent to structure* relations as objects of study. Social structures are pre-existent of agency, because individuals do not create society out of nothing, but are socialised into it. The social structures constitute internally related entities, practices, and conventions; they correspondingly have roles and positions which agents assume when acting their objectives and goals. For example, a health system has different departments, resources and relations that make it work; people take positions of ‘a doctor’ or ‘a nurse’ or ‘a patient’ to achieve their own goals while acting upon this reality of a health system. According to Bhaskar (1979), the interplay between the two constitutes the objects of social systems and he refers to this as position-practice system, because the human actions in their assumed positions transform and reproduce the social systems’ practices and structures; in turn the mechanisms of social structures (situation and context) provide resources and reasons for individuals to act in a certain way in the positions they assume. The mechanisms of social structures are either enabling or restricting to human actions.

In this sense, structure and agency are separate strata and they possess completely different properties and powers; however, one is vital and necessary for how the other will be shaped (Danermark et al., 2002). Figure 3-2 demonstrates that the social structures are the context in which human action and social interaction take place; at the same time, social interaction constitutes the environment in which the structures are reproduced or transformed.



Figure 3-2: The transformational model of the connection between social structure and agency
 Source: Danermark et al. (2002, p.180)

The intransitive entities of social reality are relations; because in social systems only relations are enduring (Bhaskar, 1998). The stratified reality of critical realism necessitates the inclusion of vertical explanations of social systems. Thus, in addition to horizontal explanations of experiences, observables and events, a scientific theory needs to explain the conditions that predetermine the realisation of actualised events (Archer, 1998; Danermark et al., 2002). The explanatory critique describing why the generative mechanisms cause certain events, relations, and experiences brings about the critic and emancipatory dimension of critical realism, which requires a researcher to engage in a critique of the mechanisms' role in social action and also their influence in society (Wikgren, 2005; Wilson & Greenhill, 2004).

The social theory of critical realism explains the social objects of social systems and the causal relationship between them; it is able to unravel the social properties of socio-technical systems and the relationship between them, while separating the systems' social structures and individual's construal and consequent action as distinct and analytically separate properties (Pettersen, McDonald, & Engen, 2010, p. 184). This qualifies the social theory of critical realism to be compatible with a wide range of social theories such as the CA framework. Archer (1998) gives a good account of what an explanatory scientific theory of a social reality of critical realism should be:

Critical realism is committed to an explanatory framework which acknowledges and incorporates (a) pre-existent structures as generative mechanisms, (b) their interplay with other objects possessing causal powers and liabilities proper to them in what is a stratified social world, and (c) non-predictable but none the less explicable outcomes arising from interactions between the above, which take place in the open system that is society (Archer, 1998, p.377)

Critical realism has explanatory models that help to attain knowledge of the qualities of the causal mechanisms capable of producing events, and how these mechanisms cooperate under specific circumstances to contribute towards the production of concrete events and processes (Dobson, 2012; Danermark et al., 2002). The three widely used models are:

1. Morphogenetic framework (Archer, 1995)

2. Stage model (Danermark et al., 2002)
3. Realist evaluation model (Pawson & Tilley, 1997)

Some studies have shown that CA framework is compatible with the assumptions of critical realism and that its explanatory power can shed insight on why and how events are produced in a particular circumstance using the context-mechanisms-outcomes patterns (Martins, 2006; 2011; McGrath, 2013; Smith & Seward, 2009).

3.3 Capability approach

CA was developed by the philosopher and economist Amartya Sen. Scholars from different disciplines have contributed to the development and clarification of CA as a framework (Nussbaum, 2000; Nussbaum, 2003; Robeyns, 2003; Robeyns, 2005a; Robeyns, 2006). CA is a normative framework for the evaluation and assessment of individual well-being and social arrangements, the design of policies and proposals about social change in society (Robeyns, 2005a, p.94). This philosophical approach is mainly concerned with people's capabilities, what people are effectively able to do and to be, to live a life they consider valuable. The core concepts in the CA framework are a person's functionings, which are beings and doings (for example, being well fed or literate), and capabilities, which are freedoms or opportunities or potentials to realise or achieve the functionings (Robeyns, 2006).

CA is gaining popularity as a multi-disciplinary analytical tool, and in the past decade it has been progressively operationalised and applied in ICT4D studies (Grunfeld, Hak, & Pin, 2011; Zheng & Walsham, 2008). The approach has been used in empirical studies to evaluate a wide aspect of people's well-being, such as individual well-being or the average well-being of the members of a group, inequality, and poverty (Hatakka & Lagsten, 2012; Morris, 2009; Zheng, 2009). Some studies, even projects and programmes, have used CA as an evaluative tool for social cost-benefit analysis, or to design and evaluate policies (Alampay, 2006b). By itself, CA framework does not explain poverty, inequality, or well-being, but it provides a tool and a space within which to conceptualise and evaluate this phenomenon. Consequently, it does not specify which variables to measure, which allows for an

exploratory approach to defining and selecting relevant capabilities enabled by resources, and the evaluation of both the process and the outcome.

A key analytical distinction in CA is between the means and the ends of well-being and development. “Only the ends have intrinsic importance, whereas means are instrumental to reach the goal of increased well-being, justice and development” (Robeyns, 2005a, p.95). She further argues that in real situations these differences are often not clear; some ends are simultaneously also means to other ends i.e. the capability of being in good health is an end in itself, but also a means to the capability to work.

3.3.1 Concepts of capability approach

The evaluation process of CA is in the spaces of opportunities, resources, entitlements, and the achievements realised. CA further analyses individuals’ preferences in the act of choice and the factors influencing the transformation of available resources into effective achievements (Zimmermann, 2006). These features delineate the main lines of investigation in CA, as summarised in Table 3-1.

Table 3-1: Key concepts of capability approach

Concept	Description	Examples
Commodity	Resources – their characteristics, access and use generate capabilities for a person	Services, products, goods
Capabilities/ Potential functionings	The alternative combinations of actions/activities that are feasible for a person to achieve – things that a person is effectively able to do and to be to live a life they value	To be health
Conversion factors	Individual capacities or personal characteristics and social structures that affect the transformation of capabilities into achieved outcomes	Intellect, socio-cultural factors
Functionings	What a person chooses to be or do from their capability set to live a life they value (achieved outcomes)	Being literate
Freedom	Choice in terms of people’s preferences and perceived value of goods (the freedom to lead different types of life is reflected in the person’s capability set).	Choice, preferences
Agency	A person’s ability to pursue and realise goals that he/she values and has reason to value	
Well-being	The state of being healthy, happy, or prosperous; welfare	

3.3.1.1 Capabilities and functionings

The ends or outcomes to well-being are people's capabilities to function. Capabilities are actions and activities that they want to engage in and being whom they want to be. They are positive opportunities/freedoms that people have to undertake to enjoy 'beings and doings' that make a life valuable (Robeyns, 2005a). Examples of functionings include working, resting, being literate, being healthy, being part of a community, being able to travel, and being confident.

The distinction between achieved functionings and capabilities (potential functionings) can be best understood as realised outcomes, and effectively possible opportunities; in other words, achievements on the one hand, and freedoms or valuable options from which one can choose from to achieve the functionings on the other (Robeyns, 2005a). For instance, having access to and knowing how to use ICT denote capabilities, and converting these capabilities to checking health information on the Internet would be a functioning.

The focus on capabilities instead of functionings is due to the value put on freedom of choice and human agency. People have the freedoms or valuable opportunities to lead the kind of lives they want to lead, to do what they want to do and be the person they want to be. Once they effectively have these substantive opportunities, they can choose those options that they value most. Two people with similar capability sets may end up with different types of achieved functionings, because of different choices following their different ideas of life they have reason to value (good life). Capabilities in CA are defined at an abstract level, leaving them vague for methodological application to empirical situations. Sen (1993) intentionally left it this way because different capabilities and functionings may be relevant in different contexts and need to be defined by the local people.

3.3.1.2 Conversion factors

The relation between a commodity and functionings to achieve different doings and beings is influenced by three types of factors: personal characteristics, social arrangements, and environmental dynamics (Robeyns, 2005a; & Nussbaum & Sen, 1993). To develop capabilities from commodities (goods and services), the conditions or conversion factors

required are not always financial resources or economic production, but involve institutional settings and political arrangements, social or cultural practices, social structures and norms as depicted in Figure 3-3.

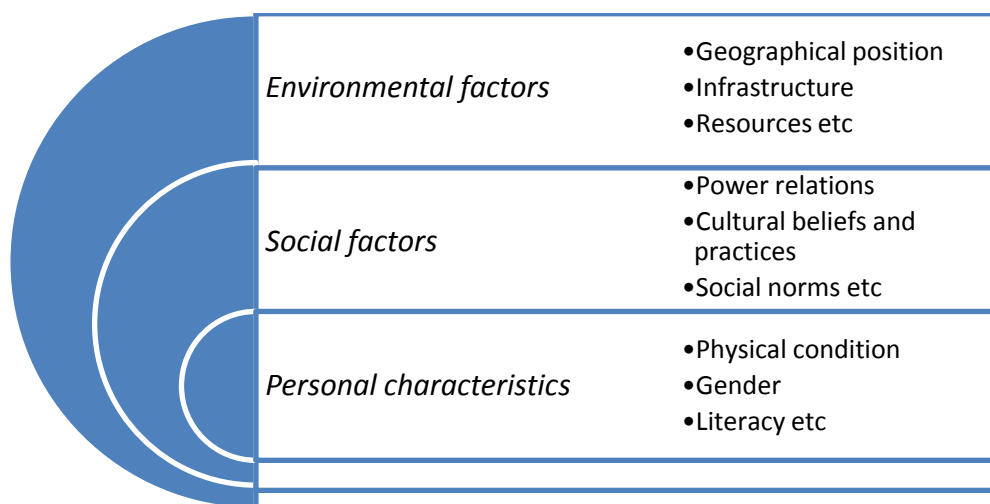


Figure 3-3: Three groups of conversion factors

The characteristics of a commodity generate a capability set for people; however, individuals' utilisation of the opportunities into functionings differs, depending on the context, which is greatly influenced by these conversion factors. For instance, for a public health intervention, disseminating health information through text messages on mobile phones in developing countries; personal factors such as literacy, can affect the way an individual reads and interprets the messages. Due to social arrangements, women would be disadvantaged as they are 21% less likely to own a phone than their male counterparts in developing countries, as a consequence of gender discrepancies (Noordam et al., 2011). In addition, environmental factors such as network coverage and electricity access pose a challenge to mobile phone use in developing countries (Chib et al., 2014; Chigona et al., 2012).

3.3.1.3 Well-being and agency

Another facet of Sen's CA is the distinction between well-being and agency goals. A person's standard of living, which is a pursuit of one's own well-being, may be one of the goals and interests. Agency may include furthering the well-being of others, respecting social and moral norms, or acting on personal commitments and the pursuit of a variety of values. This

distinction helps us to understand and explain an individual's actions. The actions in agency freedom may not be beneficial to the agent's well-being, but may focus on the overall agency. People can purposely act in ways that limit or make their well-being suffer due to commitments and other factors (Robeyns, 2005a; Zheng & Walsham, 2008). This is common in women since their lives reflect a striving after many different elements of well-being, including health, education, mobility, political participation, and others. However, most often, their preferences are distorted by their background conditions. As such, agency and freedom are particularly important goals for women (Nussbaum, 2003). An example is Lori and Bolye's (2011) mention of women in labour or having a pregnancy complication, failing to go to a health facility for medical attention for inconsequential reasons such as 'The husband who is the head of the house and makes all the decisions for her was not around to allow her to go for medical attention'. They end up injuring their capability of being healthy and, in the worst-case scenario, losing their lives or the baby.

Well-being achievements are measured in functionings, whereas well-being freedom is reflected by a person's capability set. CA is mainly concerned with a person's real opportunities in achieving his/her well-being freedom and agency freedom. The former is the freedom to have a good life and the latter the freedom to achieve what one has reason to value at personal or community level. A passive 'beneficiary' of aid can enjoy well-being freedom, without exercising agency, whereas agency freedom is something that is actively pursued (Grinfeld et al., 2011; Sen, 1985). Focusing on well-being only during evaluation limits the view of the researcher, because people's activities are not only to maximise their well-being but also that of agency (Sen, 1984). Therefore, a focus on agency as well always transcends an analysis in terms of functionings and capabilities, and considers agency goals, which yields an understanding of why and how an individual uses a commodity, the opportunities derived, and the contextual conditions affecting realisation of outcomes.

3.4 Capability approach and critical realism

As discussed previously, CA is philosophically profound but vague and abstract in methodology, so that it can be used for a wider range of purposes (Kleine, 2010; Nussbaum, 2003; Robeyns, 2005a; Zheng & Walsham, 2008). Martins (2007b; 2006) argue that CA, just

like critical realism, is an under-labouring exercise to prepare the ground for science, not a substantive theory. He starts by differentiating two types of ontology: philosophic and scientific. The philosophic ontology is at more abstract level concerned with common features in all things that exist. On the other hand, the scientific ontology is at a less abstract level, describing entities that are hypothesised in scientific theories (Lawson, 2004, as cited in Smith & Seward, 2009). CA operates in the scientific ontology, and is concerned with the description of the space in which to assess well-being rather than on the prescriptive element or criterion (Martins, 2011). CA clarifies the social categories of well-being and advantage (capabilities) at a less abstract level of scientific ontology, while critical realism addresses general properties of the social realm i.e. structures and openness/closure at a higher level of abstraction of the philosophic ontology; hence the two approaches are “complementary and mutually enriching” (Martins, 2006, p. 682). Basing his arguments on the critical realist’s philosophy of social science and the social ontology (Bhaskar, 1979), Martins (2007b; 2006) asserts that critical realism’s set of assumptions is compatible and appropriate as a meta-theory for CA, and capabilities fall within the critical realism philosophical category of causal powers with particular properties (Smith & Seward, 2009).

3.4.1 Capabilities as causal powers

Sen (2009, p.19) describes a capability as power to do something. Capabilities, like causal powers, are potentials that may or may not be exercised and/or actualised to realise a particular functioning. Capabilities are shaped by structures with particular internal relations, from which their causal powers or mechanisms, a potential to realise a functioning, emerge. The activation of the causal powers (mechanisms) may actualise a functioning. Therefore “the structures are what constitute a capability and the mechanism provides the instrumental link between this capability and the associated functioning” (Smith & Seward, 2009, p.216). The causal mechanisms of capabilities are contextual as they occur in open systems, which are complex and always determined by a multitude of factors (Martins, 2006; Smith & Seward, 2009). In this sense the concept of causal mechanisms has three components:

1. The generative mechanism of structure (x)

2. The outcome that these mechanisms tend to produce (y)
3. The elements of context that trigger or inhibit the firing of these generative mechanisms (c)

Thus, “ x causes y (in circumstances c)” (Smith & Seward, 2009, p.218). This notion of contextual causality is attuned and underpins the notion of conversion factors in Sen’s (1993) arguments, where the emphasis is put on people having different conversion factors over the same commodity. The contextual causality can be applied to understanding capabilities at two points:

First, a capability is the combination of an individual’s capacity to do something combined with the context of particular enabling (or disabling) mechanisms. Second, the realization of a capability (i.e. the functioning) will be modulated by the particular configuration of contextual mechanisms that shapes the capability.... (Smith & Seward, 2009, p.218)

Any theory in CA needs to explain the contextual causality, because outcomes of any intervention are always a result of influence from contextual conversion factors. The explanation about the interaction of context and capabilities craft an understanding of how, for whom, and in what circumstances capabilities exist and are converted into functionings.

3.4.2 Relational ontology of capabilities

Smith & Seward (2009) further argue that a capability is the outcome of the interaction between an individual’s capacities and his/her position relative to others in society inferring to the ontology of the relational society. Thus, capabilities are a product of the interactions between an agent and social structure. The social structure and their mechanisms emerge from relations between people, and between people and nature. It is at this point that Oosterlaken (2011) argues that relations between people and technology can be added too, because technology or technical artifacts are an important part of the social structure of this information age and era, and are essential for expanding human capabilities. Oosterlaken (2011) further asserts that in the analytical dualism between agency and structure within the social theory of critical realism, technology can be slotted as part of the structure in the

ontology of CA. The technology position in society is reproduced and transformed as human agents attempt to harness the causal powers of the technology, such that activities involved from technology design to technology use harness the intrinsic causal powers of material artifacts in order to extend human capabilities (Lawson, 2010; Oosterlaken, 2011).

The relational ontology shows the importance of a person's position *vis-à-vis* other people and structures, as it does not affect the individual's perspective only, but also provides objective resources and reasons that enable and constrain particular actions and events, regardless of the individual's beliefs. Thus, in assessing well-being, an intervention will have various impacts on different individuals, depending upon the individuals' capacities (i.e. skills and physical makeup) as well as their relative position in society (Smith & Seward, 2009).

3.5 Rationale for using capability approach

When using CA in terms of the critical realist ontology, capabilities are seen as causal powers, which emerge from the structures of a relational social reality (Martins, 2006; 2007a; Smith & Seward, 2009). "Capabilities have the power to provide well-being, but whether such a potential is exercised or not depends on context, or the existing set of relationships" (Martins, 2011, p.3). This conception qualifies CA framework to evaluate programmes by analysing the processes and interactions between agency and opportunity structure to understand how formal and informal structures in a given context enable or restrict the generation of capability set, freedom of choice, and realisation of outcomes. In other words, it basically seeks to understand the underlying causal mechanisms behind actualised (or not) outcomes of an intervention (McGrath, 2013). Further, CA as a framework is compatible with assumptions of critical realism, a paradigm chosen for this study in line with the research questions investigated. Therefore, the study will use this analytical tool to understand why and how the women use the mHealth intervention, and in what circumstances structures and contextual mechanisms hinder or enhance well-being from the use of the mHealth intervention.

Furthermore, CA was considered an appropriate framework for this study because it evaluates interventions according to their impact on people's capabilities, not measurable outcomes. In CA, the assessment of well-being or quality of life does not focus on resources only, but on the effective opportunities that people have to lead the lives they have reason to value (Robeyns, 2006). Central to CA are a person's capabilities and functionings, capabilities as freedoms being the range of options a person has in deciding the kind of life they want to live, and functionings (Saito, 2003). Since CA is methodologically vague, it allows for an exploratory approach, using participatory methods where members of society define and select relevant capabilities in their context through logical reasoning and debate. Thus, people are given power to express the important things that makes life valuable, that which constitutes development in their context.

Disparate from other theoretical or practical approaches that concentrate on people's happiness or desire-fulfilment, and on income, resources, primary goods, or utility, CA is concerned with human capabilities (Zheng & Walsham, 2008). The focus on people's capabilities in the choice of development or empowerment programmes makes a profound theoretical difference; it offers a different foundation for policy proposals, and is a helpful component in the critique of social norms, practices, and arrangements. This contextual causality attribute of CA that critique conversion factors influence on realisation of outcomes, yields a better understanding of how, for whom, and in what circumstances opportunities exist and are converted into functionings (Smith & Seward, 2009) – which is in line with the objectives of this study.

Access to a commodity is a necessary prerequisite to using it. CA analysis goes beyond commodity access; it articulates that individual differences, capabilities, and choices play a role in whether people make use of the commodities, how they apply them, and how they are valued (Alampay, 2006a; 2006b). With reference to ICT4D, this is in contrast to most evaluations of ICT access which do not monitor the variations in the use of ICT resources by different people but base their evaluations on general access. Of significance to CA are people's actions once they are provided access; whether they choose to use ICT or not, and how they use it. This is in agreement with the aim of this study, which is to investigate why and how maternal health consumers use mobile services and what functionings are

achieved by the use. This study considers mHealth services as a commodity or resource and focuses on what the consumers are able to be or do, given this resource, taking into account the factors that affect the generation of different opportunities, and the women's freedom of choice to utilise these opportunities to achieve the kind of life that they have reason to value.

3.6 The selection of relevant capabilities

CA is commonly critiqued as being too abstract and not having a systematic methodological guideline on how the selection of capabilities could be conducted (Robeyns, 2005b). This has led to arguments for a list of capabilities that could be used for evaluations of well-being, inequality, and social justice. The strong critique from Nussbaum (2000; 2003) is that Sen should endorse a universal list of capabilities that could be used in such evaluations. The weak critique, as considered by Robeyns (2003; 2005b), is the lack of methodological reasoning in the development of a list of capabilities. This section presents the two critiques and their arguments, and the justification why the researcher has chosen to use Sen's approach in this thesis. Finally, the section highlights the procedural methodology that was followed to come up with a list of capabilities for maternal health consumers.

3.6.1 Fixed list of capabilities

The use of capabilities in development is comparative, both at individual and collective level i.e. levels of health and education attainment in different countries. Nussbaum (2003) argues that the level of health service or level of educational provision a just society delivers as a fundamental entitlement of all its citizens should have some threshold level. She claims that this threshold level is silent in Sen's writings. As such, she advocates for an endorsement of a specific list of the *Central Human Capabilities* as a focus for both comparative quality of life measurement and for formulation of basic political principles, and defends it as universally valid (Robeyns, 2003). On the other hand, Sen has refused to endorse a fixed list of capabilities (Sen, 2004). He asserts that listing of capabilities should involve a social discussion or public reasoning, not just done by theorists – as this denies possibility of public participation on what should be included and why.

The different views on the application of capabilities approach between Sen and Nussbaum stems from their respective academic fields and expertise. With the background of law and ethics, Nussbaum's use of CA is to develop theory of justice for critiquing moral norms (Robeyns, 2005b, p.103). The central human capabilities list (Nussbaum, 2000; 2003) has ten fundamental capabilities in the categories – *life; bodily health; bodily Integrity; senses, imagination, and thought; emotions; practical reason; affiliation; other species; play; and control over one's environment*. A detailed description of these capabilities is presented in Appendix G. The list has been formulated at abstract level, but is open to plural specification, thus being translated into more detailed and specific list to suit context. Nussbaum argues that the ten capabilities are a minimum account of social justice, and that a society not providing these to some threshold level fails to be just. Her version of CA develops a universal theory of the good, applying to all social justice issues and to the world as a whole (Robeyns, 2003). This account of CA is directed to national legislative bodies, and does not give much guidance to specific microeconomic initiatives, which require much more of a participatory approach (Alkire, 2002a).

Sen's position is rooted in the field of social choice, thus he advocates for just and democratic procedures to draw up a list (Robeyns, 2003). He argues against fixing a cemented list of capabilities, which is absolutely complete (nothing could be added to it) and totally fixed (Sen, 2004). Sen's version of CA is deliberately underspecified so that it can be developed and used for various purposes and in different contexts; as such it is not possible to endorse one single list. Further, emphasis is put on the role of agency. Agents' choice and freedom should be taken into consideration when selecting relevant capabilities; thus giving a chance to people to be heard and involved in collective evaluations and decisions (Peter, 2003, as cited in Robeyns, 2003). In addition, he argues that given social conditions, public discussion and reasoning can lead to a better understanding of the role, influence, and the significance of particular capabilities. In general, Sen has no problem with people drawing up a list as long as they understand what they are doing (and in particular that they are getting a list for a particular reason, related to a particular assessment, evaluation, or critique), and they do not put themselves against other lists that may be relevant or useful for other purposes (Sen, 2004).

3.6.2 Limitations of a fixed list of capabilities

When selecting capabilities for quality of life measurement, Robeyns (2005b) argues in favour of Sen's approach, and she asserts that there are always epistemological and legitimacy limitations when a fixed list of capabilities is drawn from pure theory. Firstly, CA is used for different epistemological goals, such as quality of life measurement, descriptive analysis, and normative theories, using various methodologies. For each of these goals, capabilities take different roles (e.g. social indicators or elements of a narrative); as such there is need for different selection of capabilities as different disciplinary constraints and parameters hold for each of those goals (p.198).

Secondly, our knowledge of a phenomenon is always limited as described in this extract:

One person will almost always have a partial perspective and thus partial epistemological access, given the impact of one's situatedness. If we accept that it is very hard, and indeed often impossible, to truly understand people who live in a very different situation, then the epistemological limits of a well-defined list of capabilities become obvious. Instead, we need a process of genuine listening and deliberation until a list, which will necessarily be collective, can be constructed (Robeyns, 2005b, p.198 & 199).

Lastly, she affirms that there are always concerns of respect and legitimacy of the selection process when drawing up a list of capabilities. This process need to be legitimised by involving the people whom the list will be applied to, otherwise they might feel that it is imposed on them. The list would otherwise lack the necessary legitimacy for the list to have any political effect.

3.6.3 Criteria for the selection of capabilities

For the reason that CA is underspecified, its operationalisation results in diverse specifications when drawing up a list of relevant capabilities and functionings for a particular purpose in a given context. A few studies have looked at how this selection can be made without violating the basic tenets of Sen's CA (Alkire, 2002a; Robeyns, 2003; Robeyns, 2005b). However, developing a set of procedural methods has its own problems, especially

selection biases. These scholars agree that participatory methods with open discussions are the best approach to drawing up a list of relevant capabilities of any social arrangement. The selection process of capabilities is essential in safeguarding and defending selection biases, which are usually influenced by the life, values, and social positioning of the researcher (Robeyns, 2005b). Furthermore, to avoid epistemological biases and ensure quality, Robeyns (2003; 2005b) suggests procedural methodologies with a set of criteria that the process of selecting capabilities should meet.

A set of criteria for selecting a list of capabilities proposed by Robeyns (2005b, p.205) are:

1. *Explicit formulation*: The list should be made explicit, discussed, and defended.
2. *Methodological justification*: We should clarify and scrutinise the method that generated the list and be able to defend it. This method will be different for different uses of the CA.
3. *Different levels of generality*: If a selection aims at an empirical application or wants to lead to implementable policy proposals, then the list should be drawn up in at least two stages. Each stage will generate a list at a different level, ranging from the level of ideal theory to more pragmatic lists. This means that only from the second stage forward would constraints and limitations related to the measurement design and data collection, or to political or socio-economic feasibility in the case of policy-oriented applications, be taken into account. Distinguishing between the ideal and the second-best level is important, because these second-best constraints might change over time; for example, as knowledge expands, or as empirical research methods become more refined, or as the reality of political or economic feasibility changes.
4. *Exhaustion and non-reduction*: The capabilities on the list should include all elements that are important: no dimensions that are relevant should be left out. For example, those capabilities related to the non-market economy should also be included in economic assessments.

This set is simply a general criteria for 'check and balance' in the selection process to mitigate biases. Robeyns (2005b) further suggests that for quality of life or well-being

evaluations, different procedures are needed for small-scale projects (whether empirical assessments or policy design), large-scale empirical assessments, and large-scale policy design. This research seeks to evaluate the well-being of a relatively small group, therefore discussion shall be restricted to the small-scale projects, where it is clear as to who the affected persons are, and that all the affected persons can in principle meet to discuss the project. In such a setting, Robeyns suggests that capabilities are selected through participatory methods and debated in a group. Thus, when selecting capabilities for the assessment of a small-scale project, the most local agent(s) capable of making a decision should do it (Alkire, 2002b). In ICT4D projects, such an approach ensures a design of development projects that provide what people actually want and not just what is technically possible to implement, which is all too often the case.

This study employed Sen's approach for selecting the relevant capability set using the criteria suggested by Robeyns (2005b), as it allows for a democratic process with participatory methods where the local people are involved in capturing the real valued functionings in a specific context at grass root level. The study involved the women using the mHealth intervention and community stakeholders in making a list of capabilities valuable to the women as consumers of maternal health. The list was put forward to be debated in two focus group discussions, with women using the intervention as well. However, since the main objective of the study is to explain the underlying mechanisms linking the capabilities to outcomes, the focus has been on health capabilities and their associated effects.

3.7 The use of capability approach in ICT4D research

The last decade has seen an increase in the use of CA in ICT4D and IS studies (e.g. Gigler, 2006; Kleine, 2010; Smith, Spence, & Rashid, 2011; Vaughan, 2011). Most studies have operationalised and/or applied CA in evaluating ICT impact on development. Table 3-2 summarises selected studies that have used CA in ICT4D.

Table 3-2: Selected studies that have applied capability approach in ICT4D

Authors	Study title	Area of focus
Alampay (2006a)	Analysing socio-demographic differences in the access use of ICTs in the Philippines using the capability approach	Opportunities generated from household ICT access and use, and conversion factors
Gigler (2006)	Enacting and interpreting technology – From usage to well-being: experiences of indigenous peoples with ICTs	Conditions under which ICT enhance the well-being of indigenous people
Grunfeld et al., (2011)	Understanding benefits realisation of iREACH from a capability approach perspective	Contribution of ICT towards capabilities, empowerment, and sustainability
Hatakka et al., (2014)	Capability outcomes from educational and ICT capability inputs –an analysis of ICT use in informal education in Kenya	Evaluating ICT use in education using CA
Hatakka & Lagsten (2012)	The capability approach as a tool for development evaluation – analysing students’ use of Internet resources	Benefits of using CA when evaluating development outcomes
James (2006)	The Internet and poverty in developing countries: Welfare economics versus a functionings-based approach	Comparison of welfare economics theories and CA
Kleine (2010)	ICT4WHAT? Using the choice framework to operationalise the capability approach to development	Operationalising CA for an alternative conceptualisation of development process – individual freedom (choice)
Olatokun (2009)	Analysing socio-demographic differences in access and use of ICTs in Nigeria using the capability approach	
Smith et al. (2011)	Mobile phones and expanding human capabilities	Enhancement of human capabilities through mobile phone use
Vaughan (2011)	The importance of capabilities in the sustainability of information and communications technology programmes: the case of remote Indigenous Australian communities	Assessment of a link from ICT access and use, capabilities, wellbeing, to sustainability of ICT4D initiatives
Zheng & Walsham (2008)	Inequality of what? Social exclusion in the e-society as capability deprivation	Conceptualisation social exclusion in the e-society using CA

These studies have focused on capabilities (expansion of freedom/opportunities) as evaluative space for ICT4D initiatives, putting human development (or people) at the core of the analysis and not technology, as has always been the case with other ICT evaluating frameworks (e.g. Corneille et al., 2014; Lim et al., 2011). One exception in the application of CA is Zheng and Walsham’s (2008) study; they used CA to conceptualised social exclusion in e-society to investigate conditions under which it manifests in the use of ICT.

In the conception of CA, ICT is seen as a means to human development, rather than an end. ICT is a determinant of sustainable development; however, it is acknowledged that access alone does not guarantee development; what matters are people’s actions once they are provided access (Coeckelbergh, 2011). Alampay (2006b) argues that it is not enough just to determine whether people have the capability to access and use ICT e.g. Olatokun (2009), but need to understand the purpose and the reasons for why people use ICT and the ends

they are able to achieve with them. He concluded that “Only when people are truly free, capable and choose to apply ICTs in their lives will the use of ICTs be realized” (p.17).

3.7.1 The benefits of using capability approach in evaluating ICT4D initiatives

A number of studies have substantiated the significance of applying CA in evaluating ICT4D initiatives. James (2006) claims that there had been an absence in literature for an analytical framework for mapping the connection between ICT (i.e. Internet) and poverty at micro level. In his comparison of welfare economics and CA in evaluating ICT4D initiatives, he found that in welfare, economics benefit realisation occurs at the point of use i.e. having access to Internet. CA is, however, concerned with what is achieved after choosing to use the Internet e.g. sending an email which would expand the capabilities of affiliation. James (2006) further argues that the methodologies used in CA highlight subtle changes which could be invisible in the standard assessment of economics. This is evident in two other studies of actual development outcomes of ICT use in education (Hatakka et al., 2014:2012). The findings of Hatakka et al., (2014:2012) show that CA enables gaining a deeper understanding of why and how development outcomes are achieved, as it allows following the development process from intervention to realised outcomes, which are comprehensive outcomes, taking into account the aspect of choice as well as the characteristics of the chooser.

Gigler (2006; 2011) claims that there is no linear (direct and causal) relationship between ICT and improved well-being. This relationship is continually shaped by dynamic, multi-dimensional inter-relationships between technology and the social context; the interdependency among people, social institutions, and the technology. Consequently, for information and knowledge to play a vital role in improving the well-being of the marginalised, they need to be fully integrated into the broader socio-political realities of communities. The role of existing indigenous information systems, among other factors, is essential in influencing the extent to which access to and use of ICT can enhance the capabilities of the poor, resulting in improved well-being (Gigler, 2006). Since information is significant to many development activities, similar to enhanced literacy skills (reading and writing) in a person, improved informational capabilities through ICT can also enhance

marginalised people's capabilities to make strategic decisions and choices to achieve a lifestyle they consider value.

Vaughan (2011) assessed the strength of the linkage, in the process of empowerment from ICT use, from resources to capabilities, functionings, and well-being. It was evident that programmes which make a strong linkage among the four constructs are successful in being sustained by the community after the seed-funding stage. ICT programs which contribute to the well-being aspirations of individuals and communities through capabilities enhancement are being sustained by communities, whilst other programmes, which do not make the connection among ICT resources, capabilities, functionings, and well-being, simply provide a generic resource, such as access, and they fail, resulting in wasted resources. She further cautions that if policy makers and programme designers continue to limit their horizons to simple access without ensuring that the process of conversion to capabilities and valued functionings occur, the wastage will continue (Vaughan, 2011).

During the analysis of socio-demographic differences in access and use of ICT in the Philippines and Nigeria, Alampay (2006a) and Olatokun (2009) respectively found that gender digital divide, remoteness of location or rural-urban divide, and income were critical barriers to be alleviated if people were to have meaningful access and usage of ICT, since these contribute to other social and environmental factors such as level of education, affordability of ICT, physical availability of ICT, and access to the ICT infrastructure. Grunfeld et al. (2011) claim that people require a minimum set of capabilities to make effective use of ICT, and that use of ICT in turn strengthen capabilities, empowerment, and the ability to maintain sustainable livelihoods. The use of ICT makes access to information easier and helps in decision making that improve learning, community empowerment, and cooperation, health, and agriculture in Cambodia (Grunfeld et al., 2011). Furthermore, ICT contributes to gender empowerment; this enables and motivates women to participate in community activities – the women who were allowed to do so by their husbands and parents.

In another study investigating essential capabilities in the e-society and those who may be disadvantaged when deprived of these capabilities, Zheng and Walsham (2008) apply the

elements of CA in a totally different way. They conceptualise social exclusion as capability deprivation, affecting wellbeing and agency freedom, in two case studies from China and South Africa. It was found that the social exclusion in e-society can manifest diversely under different conditions as deprivation of different capabilities; this is usually masked by technological diffusion. As such, ICT policies need to go beyond technological provision and concerns about access, and regard socio-political, cultural, and institutional aspects as vital to ensuring effective utilisation of information and channels of communication, which should serve to enhance people's opportunity to better participate in economic, social, and political activities (Zheng & Walsham, 2008).

3.7.2 Capability approach and mobile phone research

Some scholars have shown evidence that mobile phones are making substantial contributions to capabilities and freedoms in economic, social, and governance spheres (Aker & Mbiti, 2010; Smith, Spence, & Rashid, 2011). Mobile phones and their networks enhance capability sets of users through the changing of their positions in relation to important development resources, by increasing access to timely and/or relevant information, and expanding possibilities for connectedness between people (Smith et al., 2011). Smith et al. (2011) further assert that these capabilities enable or strengthen three categories of networks central to enhancing well-being. Firstly, social networks, especially in the rural and poor contexts, are vital for well-being, survival, and security purposes. Secondly, economic networks connect citizens and financial institutions, expand market boundaries, and improve supply chains. Lastly, governance network increases access to government services, political mobilisation, election monitoring, early warning systems, and crisis management. The benefits of mobile phones are greater in resource-constrained settings for marginalised populations; these benefits also apply, even for those who do not own a mobile phone and only access mobiles through the sharing or mobile phone kiosks (Smith et al., 2011). In the same vein, Sen (2010, pp.1-2) asserts that "A telephone – and particularly one that is readily usable by the owner and others – is generally freedom-enhancing in the sense that it helps others to call the person up, as well as to receive calls from him or her, and so the increased freedom of the phone owner adds to the freedom of others".

The common denominator in these studies is that well-being achievement through the use of ICT can only be achieved when there is meaningful use that enhances informational capabilities. The process from ICT access to realisation of desired outcomes is mediated by contextual factors, some of which are subtle and can be easily neglected or masked when using other theoretical lenses. This study attempts to contribute to this topic by analysing the processes that link ICT access and use to realised outcomes. It focuses on how and why mHealth outcomes are produced, and under what circumstances, for maternal health consumers.

3.8 Critiques and limitations of capability approach

Despite its potential to change the way development is conceived and evaluated, especially in developing countries, CA has been criticised to have the following limitations:

1. CA is under-specified and is hard to operationalise for empirical analysis.
2. CA is too individualistic, with little attention paid to groups and social structures.
3. CA is incomplete and requires supplementation from other social theories to undertake specific evaluations and analysis.

The number one critique of CA pertains to being under-specified and hard to operationalise for empirical analysis, as it does not prescribe a list of capabilities to be taken into account when evaluating policies and programmes (Clark, 2006; Gasper, 2007). Arguments and justification for this critique have been addressed in detail in Sections 3.4 and 3.6.

Another common critique is that CA is too individualistic, with little attention paid to groups and social structures (Deneulin, 2006). The argument is that CA does not acknowledge that the interaction between an individual and the social structures in which a person is embedded can lead to collective capabilities being created as well. Nevertheless, a framework dealing with capabilities of individuals ought to recognise that individuals as agents are socially embedded and connected to social structures in their environment, and should analyse the role of collective actions, institutions, and other social structures in creating individual capabilities (Alkire, 2008). As such, development should be seen beyond the consequences for individual human well-being (Deneulin, 2006).

To counter this critique, Alkire (2008) and Robeyns (2000) argue that CA embraces ethical individualism, which claims that individuals, and only individuals, are the ultimate units of moral concerns, and the social structures and institutions should be evaluated in virtue of the causal importance that they have for individuals' well-being. Robeyns (2000, p.17) further argues that CA accounts for social relations and the constraints and opportunities of societal structures and institutions, by recognising the social and environmental factors which influence the conversions of commodities into functionings, and also by theoretically distinguishing functionings from capabilities. The process of utilising capabilities into functionings requires an act of choice, which takes into account societal structures and constraints. Sen (2002) asserts that even though the achievement of individual capabilities is dependent on the societal interactions, the capability obtained is not a collective one; it still remains an individual capability – socially dependent individual capabilities. Sen continues to argue that:

The intrinsic satisfactions that occur in a life occur in an individual's life, but in terms of causal connections, they depend on social interactions with others. The socially dependent individual capabilities have to be distinguished from what are genuinely 'collective capabilities,' such as the capability of a world nuclear power to kill the entire population of the world through nuclear bombing (Sen, 2002, p.85).

Zheng (2009) claims that CA still remains incomplete in the sense that it requires supplementation from other social theories to undertake specific evaluations and analysis, and the choice of different theories may yield different outcomes (p.73). This concern is valid but CA operates at the level of scientific ontology, describing the space to evaluate well-being (Martins, 2006). Integration of other theories into CA would enhance its explanatory power and illuminate some aspects of a phenomenon in a particular context in a way that could not have been possible using one framework. The explanatory power of such integrated theories would make significant contribution to the body of knowledge. Further, the supplementation from other social theories to enhance CA explanatory power is in line with the assumptions and methodology of critical realism used in this study (Danermark et al., 2002; McGrath, 2013).

3.9 Summary of the chapter

In contrast to other theories which suggest that development and social arrangement approaches should maximise utility (people's happiness) and income, the CA proposes that social arrangements should aim at expanding people's capabilities, their freedom to promote or achieve valuable beings and doings. Thus, the space for assessing well-being is capabilities of an individual. Capabilities are seen as causal powers merging within a relational social reality of critical realist ontology that may or may not be exercised, depending on the context and set of relationships, to actualise outcomes. In CA, the ultimate assessment of progress, development, or poverty reduction is whether people have real freedoms to live a life they value. Capabilities, functionings, commodities, conversion factors, and agency are the main concepts of CA framework; they help with examining the process of why or why not people use resources and how they use them in a particular context to achieve outcomes that hinder or enhance well-being.

CA has been used in ICT4D and IS research, and is gaining popularity in the evaluation of development and social arrangement in ICT4D initiatives. The framework has criticisms and limitations of being under-specified, incomplete, and too individualistic. The aim of this study is to evaluate the impact of mHealth on individual maternal health consumers from their perspective, using their own narratives. As such, the study is not affected by the limitations of being under-specified and incomplete. These limitations do not affect, and are compatible with, the procedural methodologies chosen for the investigation.

The next chapter discusses the methodology and the steps taken in the research process.

4 RESEARCH METHODS

4.1 Introduction

The previous chapter discussed the tenets of critical realism and CA as a conceptual approach guiding the study. Based on the theoretical set of assumptions deliberated in the previous chapter, this chapter discusses the research strategy and the methods employed for conducting the research. The chapter presents critical realism methodology, qualitative methods, and case study strategy as chosen approaches for the study. It further discusses the data collection and data analysis stages of the research process. Validity and reliability of data is demonstrated and defended, ethical issues presented, and the chapter concludes with a summary of the research process. The chapter also provides the rationale behind the decisions and choices with regard to research approach and methods.

4.2 Critical realism methodology

The goal of critical realism research is to develop explanations of events observed in the empirical realm, how they happen or come about. Unlike positivism and interpretivism which are concerned with discovering universal laws and description of meanings and beliefs respectively, critical realism focuses on using the perceptions of observed and experienced events to identify the mechanisms that give rise to these events (Dobson, 2012; Zachariadis et al., 2013). The core methodological approach espoused in critical realism is retrodution. This is a mode of inference in which events (or their absence) are explained by postulating and identifying the underlying mechanisms or structures which, if they existed, would be capable of producing them (Sayer, 1992). Retrodution is referred to as a *thought operation* (Danermark et al., 2002), which moves “between the knowledge of empirical phenomena as expressed through events to the creation of explanations (or hypothesising) in ways that hold ontological depth and can potentially give some indications on the existence of unobservable entities” (Zachariadis et al., 2013, p.858). With retrodution a researcher seeks to clarify the basic preconditions (circumstances without which something cannot exist) for social relationships, people’s actions, reasoning, and knowledge (Danermark et al., 2002).

Social systems are dynamic and complex open systems, constituting a combination of multifaceted structures and their relationships; which makes it difficult to isolate and examine under controlled conditions a phenomenon of interest (Sayer, 1992). As depicted in Figure 4-1, different mechanisms have potential to cause similar events or effects, which can lead to misattribution of causality if not properly examined. For this reason, it is important to individuate structures so as to best understand their properties and their internally related objects that constitute their being to determine what they can or cannot do (Sayer, 1992; Sayer, 2000).

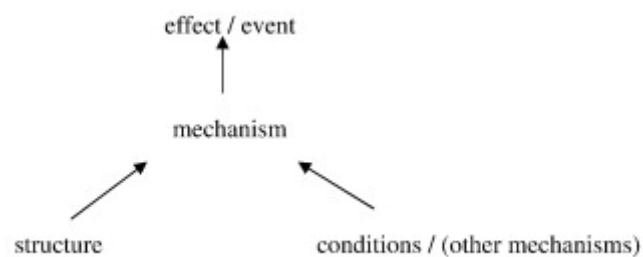


Figure 4-1: Critical realist view of causation
Source: Sayer (2000, p.15)

Mechanisms or causal powers exist by virtue of the nature of the object that possesses them; however, it is contingent whether they are exercised. Besides when they are exercised, the actual effects of their causality are dependent upon the conditions of the context in which they are working, making the outcomes not fixed but varied, depending on the context.

Most mechanisms exist independently of their effect, except in special cases where they are derived from social structures whose reproduction depends upon a particular effect resulting (Sayer, 1992). Thus, in addition to identification of causes of events, it is vital to include references to the context, necessary conditions, for the existence of the mechanisms. The mechanisms, and not their effects or outcomes, form the basis of theory development in critical realism, since they do not change in different circumstances. Thus: “Theory generation is based on the theoretical abstractions that hypothesise about and identify generative mechanisms (rather than regularities) that are observed in different context and are expressed by means of empirical categories – empirical generalisations”

(Danermark et al., 2002, as cited in Zachariadis et al., 2013, p.876). Generalisation in critical realism is concerned with identifying universal structures or mechanisms that are theorised to exist in different contexts, but do not necessarily cause the same events (Zachariadis et al., 2013).

Since theorisation in critical realism is contextual, identifying mechanisms that give rise to outcomes in a particular circumstance, scholars advocate for the use of middle-range theory (MRT) in critical realism theory development (Danermark et al., 2002; Merton, 1968; Pawson, 2010). This is due to MRT being capable of providing an account of the underlying mechanisms that co-determine uniformities and demi-regularities in some cases (Bhaskar, 1978, as cited in Pawson, 2010). A middle-range theory refers to:

Theories that lie between the minor but necessary working hypotheses that evolve in abundance during day-to-day research and the all-inclusive systematic efforts to develop a unified theory that will explain all the observed uniformities of social behaviour, social organization and social change (Merton, 1968: 39).

MRT falls in between grand theories and concrete description (empirical data). Merton (1968, p.39) asserts that MRTs “are close enough to observed data to be incorporated in propositions that permit empirical testing”. These propositions are formulated from the theory to test it. In this approach, “the theory points at an abstract mechanism and the hypothesis at a more concrete circumstance” (Danermark et al., 2002, p.127). This kind of theory development allows for separation of necessary conditions from contingent ones in developing a causal pathway that can explain ‘how, for whom and in what circumstances’ of observed effects (McGrath, 2013; Pawson, 2010).

4.2.1 Research design

The explanatory theory building methodology³ of critical realism starts with concrete research, describing the phenomenon of interest, to the abstract, where theories are used to reinterpret the observed events and hypothesise the necessary conditions for their

³ This has been explained in detail in Danermark et al. (2002) pages 109-111 and Eastwood et al. (2014) pages 3- 4

occurrence, and finally back to the concrete for substantiation of the mechanisms identified (Danermark et al., 2002). As the explanatory theory building process traverses from the concrete, to abstract, and back to the concrete, it involves all forms of reasoning, starting from induction, abduction, retroduction, to deduction (Danermark et al., 2002; Eastwood et al., 2014). Generally, research starts with an exploratory investigation of the phenomenon, describing the events and situations intended for the study. Then the analysis process begins with distinguishing components and aspects of a phenomenon in a way that they can be studied in an open system. This is followed by abduction and retroduction; to a stage where the explanatory power of different theories and abstractions are compared, and sometimes even integrated. The last stage involves substantiating the theorised mechanisms in different situations.

Different scholars have described this explanatory research process in different ways and stages (e.g. Eastwood et al., 2014; McGrath, 2013; Pawson & Tilley, 1997), but the underlying principles are the same. This study espouses to the explanatory theory-building process proposed by McGrath (2013), which is specific to ICT4D research, as demonstrated in Table 4-1.

Table 4-1: Retroductive process in the context of explanatory ICT4D research

Stages	Description
Phenomenon description	Explication of events, structures, and context of the phenomenon of interest in terms that would make it relevant and amenable to the concepts of a particular theory or theories i.e. CA
Retroduction	Hypothesising the mechanisms whose existence would generate the observed phenomenon of interest
Elimination of competing explanations	Substantiating the existence of mechanisms through further empirical research and eliminating those with less explanatory power
Theory development	Identification of the generative mechanisms that provides the best approximation of the observed reality and appropriate development to the theoretical base

Source: McGrath (2013, p.10)

This research process was developed in the context of ICT4D evaluation, with examples using CA as an evaluative framework for ICT4D initiatives (McGrath, 2013, p.10). The process starts from concrete research, a phenomena that needs to be explained e.g. access to maternal healthcare using mobile technology in this case. The first stage is concerned

with the review of literature pertaining to the phenomenon of interest and/or an exploratory study to understand and describe the events, structures, and context involved; laying ground for the conjecturing of the mechanisms. In the case of this study, the description focused on the necessary capabilities to achieve maternal well-being through access to and utilisation of healthcare, using mobile phones. Since the kind of evaluation is context-mechanism driven and not programme led, it involved a systematic review of theories on the use of mobile technology. The synthesised theory from literature and evidence from the empirical situation postulated potential mechanisms that can produce the outcomes and contextual dynamics with potential to enable or constrain these causal powers (McGrath, 2013; Pawson & Tilley, 2004).

Retroduction produces propositions with patterns of Context-Mechanisms-Outcomes, which need to be subjected to further rounds of empirical work. The theoretical conceptualisation needs to be related back to the complexity of the concrete empirical situation of the object of interest for confirmation of the mechanisms in an iterative process, back and forth from concrete to abstract research until the theory is validated. The purpose for rigorous corroboration of the mechanisms is to find the ones that provide the best explanation on the basis of empirical evidence (Danermark et al., 2002; McGrath, 2013). In an ideal critical realism investigation, this stage involves so many rounds of empirical work, where mechanisms with less explanatory power of the observed event(s) are eliminated, either by being removed or incorporated within another mechanism with greater explanatory power. The final stage identifies the mechanisms that provide best approximation of the observed events, and these are incorporated in a wider network of theory or theories i.e. CA in this case, either to refine the general claims of the theory or complement it with new insights.

A research design connects the empirical data to the research questions and research conclusions in a logical sequence (Yin, 2009, p.26). Research questions in critical realism focus on the causes of the events associated with the phenomenon interest, searching for mechanisms in a particular context (Easton, 2010; Wynn & Williams, 2012). Therefore, the main research question guiding this study is: ***How are maternal health outcomes achieved through the use of mobile phones by women in developing countries?*** This has been answered through the following sub-questions:

1. What are the effects of mHealth in maternal healthcare for women in rural Malawi?
2. How do contextual factors influence the realisation of mHealth outcomes in maternal healthcare for women in rural Malawi?
3. What causes mHealth outcomes for maternal health consumers in rural Malawi?

To answer these research questions, the study took the steps demonstrated in the research map depicted in Table 4-2.

Table 4-2: Stages in the Research Design

Stages in research process	Thesis Chapter	Study Objectives	Methods
Theory	Chapters 2	Describing structures, context, and outcomes	Systematic literature review on ICT4D, M4D, and maternal health
Case description & analysis	Chapter 5	Describing structures, context, and outcomes	Inductive analysis of MSSM intervention theory, context and outcomes
Observation - Selection of appropriate data collection	Chapter 4	Phase 1: Exploratory study Phase 2: Testing the propositions	Document analysis Case study method using semi-structured interviews, focus group discussions, participant observation, and field notes
Theoretical redescription and retrodution	Chapter 6	Reframing the study using theories; identification of mechanisms; conjecturing propositions	Abduction and retrodution analysis
Analysis of hypotheses	Chapter 7	Systematic testing of the propositions using the empirical data	Deductive analysis using pattern matching and thematic analysis using the concepts of CA and identified mechanisms
Theory development	Chapter 8 & 9	Assessment and interpretation of the analysis; and concluding remarks	Review of the results of the MSSM case study in line with the research aim and objectives, and the propositions

A systematic review of literature on ICT4D, M4D, and mHealth was done in Chapter 2. Theories of maternal health in developing countries were also analysed to understand the contextual and situational factors that brought about the events (or their absence) i.e. high MMR, that mobile technology use would change. A review of ICT4D, and M4D in particular, was carried out with the aim of describing the structures and context within which mobile technology use for development takes place and outcomes of such initiatives and interventions in developing countries. This review was further narrowed down to mHealth

and mHealth in maternal healthcare to understand the necessary conditions that make mHealth work or not.

Chapter 3 looked at the theoretical approach taken to carry out the study. Chapter 5 explicates the case context, structures, and programme theory. Using the analysis from the exploratory study of MSSM and literature review, a theoretical redescription using CA is presented in Chapter 6. The retroduction process involved integrating other theories that best explained the characteristics of mHealth as a commodity for development, agency in the process of empowerment, and health system as institution. Chapter 7 presents the findings of the empirical corroboration of the mechanism and propositions conjectured in the case of MSSM. Chapter 8 and 9 discuss the finding of case analysis and their implication on theory and practice.

4.2.2 Research methods in critical realism

The methodology of critical realism uses different types of research methods to generate nuanced explanations of the causal generative mechanisms, as shown in Figure 4-2. However, the emphasis on studying complex and dynamic relationships in contexts that are geographically and historically conditioned, favours intensive research approach using qualitative methods, since they generate explanatory and descriptive theories about potential mechanisms that could have produced observed events (Zachariadis et al., 2013). Zachariadis et al. (2013) further asserts that in such cases theories are easier to use than testing a theory using empirical effects; quoting Sayer (1992, p.143) they reasoned that:

“Theories help to conceptualize objects and structures ‘at the abstract level about necessary or internal relations’ while they ‘remain agnostic about relations which are contingent’ (external) that rely on empirical questions and on observing actual cases at the concrete level” (Zachariadis et al., 2013, p.863).

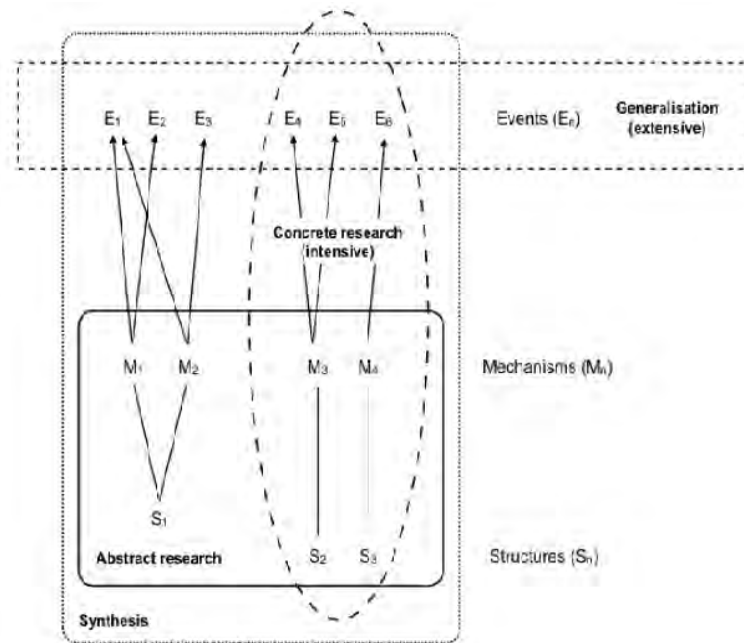


Figure 4-2: Types of research methods in critical realism
 Source: Zachariadis et al. (2013)

The role of qualitative or intensive methods within critical realism is more profound than extensive methods as it traverse all the layers of the stratified ontological depth, uncovering the contextual factors and distinguishing them from the *necessary* (internal) aspects of objects and structures leading to an empirical event (Sayer, 1992; Zachariadis et al., 2013). Intensive research using case study helps with the excavating of underlying structures and mechanisms; however, the use of extensive methods or evidence from such studies yields an understanding of the empirical events that are pointers to the generative mechanisms and structures (Dobson, 2001a). In social programmes, it is usually the events that are observed or experienced, while the mechanisms and structures may or may not be observable, necessitating the use of inferences from observable events. Thus, the choice of methodology in critical realism depends on the capability and complementarity of different methods to convey different kinds of knowledge about generative mechanisms (Zachariadis et al., 2013, p.864). Since this study aims to evaluate the effectiveness of mHealth on maternal healthcare consumers through the analysis of the processes that take place from use to realisation of outcomes, an intensive case study using qualitative research method was employed to unearth the underlying mechanisms and contextual factors that produced both mHealth intervention outcomes and maternal health outcomes for the consumers.

4.3 Qualitative research

Given the focus on underlying mechanisms and context that are capable of producing outcomes, this study draws on qualitative data. Qualitative research in IS evaluation refers to a broad class of empirical procedures designed to understand, describe, and interpret the perception and experiences of users of an information system, the context within which the system is implemented or developed, and the processes by which changes occur or outcomes are generated (Kaplan & Maxwell, 2005, p.35; Ponterotto, 2005). This study employed qualitative methods to evaluate the effects of mHealth on maternal healthcare consumers in Malawi, mainly due to its propensity to create situated analytical explanations that reveal potential structures and mechanisms (and their qualities) that might have been involved in generating observed outcomes for the women (Zachariadis et al., 2013). Qualitative methods have a profound role in critical realism, since they use 'epistemologically valid' empirical procedures i.e. interviews and case studies to collect data (Tsoukas, 1989, p.556, as cited in Zachariadas et al., 2013); and are capable of describing a phenomena, constructing propositions and identifying structures and interactions between complex mechanisms involved (Mingers, Mutch, & Willcocks, 2013).

The primary goal of qualitative research is to find out *what* is happening and *why* is it happening in a particular way (Kaplan & Maxwell, 2005); this is similar to the objectives of this study. The main concern is on examining the dynamics of a process involved for an event to occur in a particular way. In addition, corresponding to critical realism assumptions, qualitative methods analyse the context of a phenomena, taking into account that society is an open system and events are influenced by contextual issues i.e. social, cultural, organisational, and political concerns surrounding an information technology use (or lack of use); how all these are conceptualised and perceived by the participants in their natural setting (Kaplan & Maxwell, 2005, p.31). Unlike quantitative methods, qualitative methods do not simply reveal the causal relationships that exist, but they examine the causal processes by identifying the structures (their relationships and interactions) and the mechanisms involved in generating an event. Qualitative methods, through a systematic analysis of the qualities of internal properties and relations of objects and structures, are capable of isolating necessary conditions (circumstances without which something cannot

exist), thus mechanisms from contingent ones attributing to an event's occurrence (Meyer & Lunnay, 2013; Sayer, 2000).

Causality in critical realism is not about a relationship between two events where one follows the other, as usually demonstrated by quantitative approach. But it is concerned with the process and conditions under which one event *X* causes another event *Y* (Bhaskar, 1998; Danermark et al., 2002). The use of qualitative methods allows the researcher to get inside the black box to discover the actual processes involved in producing the events. Kaplan and Maxwell (2005) concluded that:

Qualitative research is particularly useful for developing explanations of the actual events and processes that led to specific outcomes, or when causality is multidirectional and there is no clear effect or impact of one factor on some specific outcome (p.33).

Thus, it yields explanatory theories and descriptions of how and why processes, events, and outcomes occur in a particular way.

The strategies of inquiry used in qualitative approach such as narratives, case study, grounded theory, and ethnography yield data with in-depth detailed accounts of participants, from which themes can be developed to derive meanings for theory building – which is in line with the purpose of this study. Qualitative research methods helped the researcher to understand the users of the MSSM intervention, the social and cultural contexts within which they lived, and their use of mobile technology for health, from their own points of view. Kaplan and Maxwell (2005) argue that this purpose is lost when textual data are quantified and aggregated.

Nonetheless, qualitative methods have hitches and limitations. To start with, they are time-consuming, requiring a lot of planning and organisation and, if not properly conducted, can result in anecdotal evidence that does not inform policy formulation. Qualitative methods are also criticised for not being representative, lacking rigour, are difficult to validate and corroborate. The strategies used to counteract these limitations are explained in detail in Section 4.7.

4.4 Case study research method

The aim of this section is to demonstrate that case study strategy is appropriate for critical realism and the phenomenon under study. There is no standard definition of case study. However, this research strategy refers to a detailed investigation that uses different methods of data collection, of a phenomenon, within their natural setting through an iterative research process (Benbasat, Goldstein, & Mead, 1987; Easton, 2010; Hartley, 2004). Case study does not separate the phenomenon from the context, as it aims to provide an analysis of context and processes that cause events associated with the occurrence of the phenomena (Hartley, 2004; Wynn & Williams, 2012). It seeks to understand how actors' behaviour or processes are influenced, or influence the context, hence the focus is on understanding the dynamics of a contemporary social event in a natural setting. Case study research strategy offers a key opportunity to understand a phenomenon thoroughly and comprehensively in fields like mHealth where research and theory are in an infancy stage, and where the attitudes, behaviour, and experiences of actors are important and the context of action is critical for the realisation of outcomes (Benbasat et al., 1987; Chigona et al., 2012).

Case study can be applied to explain complex causal links in real-life interventions; describe the real-life context in which the intervention has occurred; describe the intervention itself; and explore situations in which the intervention being evaluated has no clear set of outcomes (Yin, 1994). This strategy helps a researcher to answer the 'how' or 'why' questions which can be explanatory in nature and deal with operational links needing to be traced over time, rather than mere frequency or incidence (Yin, 1989; 2003, as cited in Easton, 2010). Case study research allows the researcher the opportunity to tease out and disentangle a complex set of factors and relationships, to understand the complexity of the processes taking place within some real life context when the investigator has little control over events (Yin, 2009). In addition, case study method is highly flexible and works with uncertainty and even in conditions where there is no clear boundary between a phenomenon and its context (Yin, 2009).

4.4.1 Case study and critical realism

Case study strategy is optimal for investigations that seek to unearth the causal mechanisms and contextual factors that combine to generate contemporary socio-technical phenomenon in IS research (Easton, 2010). Thus, it is well suited to conduct critical realism research as it is compatible with the assumptions of critical realism ontology and epistemology for developing explanatory theory (Wynn & Williams, 2012), as depicted in Figure 4-3.

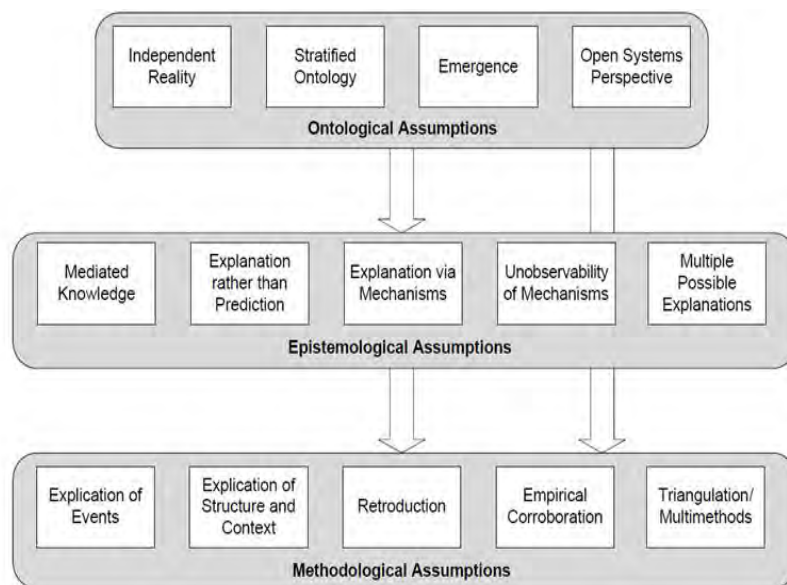


Figure 4-3: Methodological principles for case study research in critical realism
Source: Wynn & Williams (2012)

Furthermore, as an intensive concrete research method, it traverses all the layers of the critical realism's stratified ontology in excavating the structures, underlying mechanisms and contextual influences that generate outcomes to develop a causal explanation. The strength of case study to describe and explain phenomena in their real life context by tracing the processes and context that have produced events leading to the occurrence of the phenomenon makes it an appropriate approach in critical realism, to explore the interaction of structure, agency, events, actions, and context to identify and explain generative mechanisms (Easton, 2010; Mingers, 2004b; Wynn & Williams, 2012).

Wynn and Williams (2012) propose methodological principles, shown in Figure 4-3, for conducting a critical realist case study research in IS to develop and support in-depth

explanations for the outcomes of IS phenomena that take into account IT (the artifact and intervention in general), personal, social, and environmental factors that may have contributed to their happening. The methodological principles cover explication of events, structures, and context that lay the foundation for a theoretical redescription of the phenomenon and the postulation of mechanisms that could have caused the events, in the retroduction stage. They further emphasise the need to test and confirm the developed propositions and theories in a concrete empirical situation or case, using multiple methods of data collection and analysis. These five methodological principles for conducting critical realism case study research in IS are similar to the stages of a retroductive research process in ICT4D by McGrath (2013), that this study has used to investigate how mHealth outcomes for maternal healthcare consumers are produced.

The multi-method approach in a case study within the critical realism paradigm does not necessarily mean a combination of quantitative and qualitative approaches only, but also the use of different data collection and analysis methods in qualitative or quantitative research alone (Danermark et al., 2002; Pawson & Tilley, 1997; Zachariadis et al., 2013). For instance, the use of participant observation, interviews, focus group discussions, and documentary analysis to collect data from a case study is a multi-method approach in a qualitative research (Hartley, 2004). Quoting Yin (1994), Hartley (2004) posits that, in case study data, analysis is like detective work, using different techniques one must sift evidence (some relevant, some not) to build inferences about events or outcomes, and why they happened in what circumstances. Thus, the use of multi methods helps to uncover the complexity of a phenomenon using several techniques which best expose causal factors inherent in a particular structure, relationships among the actors, and settings that are capable of producing the phenomenon (Hartley, 2004; Wynn & Williams, 2012).

4.4.2 Case selection

A case refers to a meaningful but complex configuration of events and structures in a research setting or sites within which data is collected from and analysis is conducted (Ragin, 2004). Benbasat et al. (1987) advise that site selection should be carried out with caution rather than being opportunistic, because it is crucial to answering the research

question. Seawright and Gerring (2008) propose seven procedures for selecting a case study as a way of reducing bias and inaccuracy of results through finding a representative sample with useful variation on the dimension of theoretical interest (p.296). Each procedure works with a different within-case analysis strategy, since they focus on different aspects of cases as illuminated in their names: typical, diverse, extreme, deviant, influential, most similar, and most different cases. Critical realism espouses single cases of a typical kind that reflect events and structures that could have led to the occurrence of the phenomenon of interest and would help in answering the main research question (Wynn & Williams, 2012).

In addition to providing rich descriptions, single cases also provide in-depth investigation of structures for the purposes of testing, uncovering, or refining the hypothesised causal mechanisms and contextual conditions (Bennett & Elman, 2006; Darke, Shanks, & Broadbent, 1998). This in-depth contextual analysis of complex processes is vital in critical realism for testing and confirming the middle range theory developed, as asserted by Yin (1994): that to confirm and challenge a theory, there is need for a single case that meets all the conditions for testing the theory. As such, the use of a single case in a specific setting is perceived as an optimal way for building an explanatory theory that matches the empirical facts as closely as possible, and it further enables the development of detailed context-sensitive causal explanations of a specific phenomenon (Easton, 2010; Wynn & Williams, 2012).

A single case of MSSM intervention in a remote area of Malawi was selected for this study as a typical case that could represent and reveal the effects of mHealth on maternal healthcare consumers in a developing country context, mainly because it had the potential to disclose more information by activating more actors and more basic mechanisms in the situation studied than expected in a typical case (Flyvbjerg, 2006). Detailed information on site selection and programme selection is presented in the following Section 4.4.4 and 4.4.5 respectively.

4.4.3 Unit of analysis

A case study requires identification of a level of social entity that a study plans to focus on – a unit of analysis (Ruane, 2005; Yin, 2009). A unit of analysis defines what the case is all about. This study focused on the MSSM intervention as a unit of analysis. As reflected in the research questions, the main goal of the research is to examine the causes of the outcomes of the intervention for the mothers as consumers of maternal healthcare, by analysing the processes that take place from mobile technology use to the realisation of outcomes. Women, as users of the intervention, were initially considered as the unit of analysis. However, this was considered inappropriate since the study does not focus on the effects of mHealth on their lives as individuals, such as how the outcomes are benefiting their lives i.e. improving their wellbeing. As asserted by Darke et al. (1998), having a unit of analysis that is informed by the research question makes it easier for the researcher to know where to get the answers for the study, with whom to talk, and where to focus in observations.

4.4.4 Site selection: Malawi

Malawi was deemed an appropriate context for the study because it has high MMR. Malawi is one of the countries in the developing world with MMR exceeding 650 deaths per 100 000 live births (Malawi NSO & ORC Macro, 2011). In 2004, the MMR of Malawi was at 984 per 100 000 live births and this has decreased to 675 per 100 000 in 2010, with a projected rate of 435 in 2015 against a MDG target of 155 (Bowie & Geubbels, 2013, p.8). Malawi is lagging behind the MDG target of reducing MMR by 75%, and the other reproductive health targets (skilled delivery attendants and contraceptive prevalence) are also unlikely to be met (Bowie & Geubbels, 2013). Recently the government of Malawi implemented a road map for accelerating the reduction of maternal and new-born deaths, but the results may take longer to materialise, going beyond 2015 (Ministry of Health [Malawi], 2005).

Like other developing countries, Malawi has espoused the use of ICT for development. With the help of the international community through development agencies, Malawi has started a number of ICT4D projects throughout the country to promote computer literacy and bring about ICT-led development (Banda & Chikumba, 2014). Some of these projects are

implemented in the health sector to reduce the burden of communicable diseases such as HIV/AIDS and TB, and also to improve maternal health. A number of mHealth interventions are being piloted in maternal health with the aim of informing and educating the women about pregnancy care, providing medical services to the women while at home, and ultimately reducing the delay in seeking maternal healthcare service.

4.4.5 Programme identification and selection

mHealth practice and research in developing countries are still in their infancy and most projects are in the pilot phase, with a few being rolled out nationally (Chigona et al., 2012; McQueen et al., 2012; Mechael et al., 2010; Mendoza et al., 2013). Most mHealth pilot projects in the Sub-Saharan region, especially in maternal health, were implemented between 2010 and 2012 with a lifespan ranging from one to three years. In addition, usability and effectiveness evaluations are conducted from three months of implementation (McQueen et al., 2012; Mendoza et al., 2013). mHealth interventions were first introduced in Malawi around the year 2007 with the use of Frontline SMS system for CHWs working with TB and HIV-AIDS patients in rural areas (Mahmud, Rodriguez & Nesbit, 2010). Data collection for the study commenced in the year 2012. By 2012, there was still a dearth of mHealth interventions as a number of projects were still in the design phase. As such, it was not easy to find a project to work with for this study. Using Internet search and consultations with researchers at the University of Malawi and government officials, the researcher identified four mHealth interventions working in maternal, neonatal, and child health (MNCH). All four projects were planned to be implemented in various parts of rural areas of Malawi for education awareness and improvement of health-seeking behaviour in women to reduce maternal morbidity and deaths. All four interventions were planned to use text messages either through CHWs or directly to the mothers and caregivers, and only one had a toll-free line case management.

Two projects out of the four were still at system development stage during the time planned for data collection. The researcher wrote emails to the remaining two projects, which had started piloting their mobile system in two different districts and regions of Malawi, requesting permission to collect data for the study. One of the two projects started using

the mHealth system in 2010 while the other in 2011. Fortunately, the researcher got a response from the project manager of the project which started working in 2011: the Mobile System for Safe Motherhood (MSSM). The project manager of the MSSM intervention tabled the request to collect data from the project at a board meeting with the donors of the project. Permission to collect data and access to the project was granted in June 2012. Data collection for the main phase of the study was done from September 2012 to December 2012.

The MSSM project was planned to be piloted for a period of two years from July 2011 to July 2013. During the time of data collection, the project had been in operation for one year and three months. The use of intensive methods to understand the interventions outcomes for the women and the processes through which they were derived, yielded insights on the effectiveness of the MSSM intervention. However, one year of operation could be too short a period to come up with concrete evaluation evidence; as such, findings from the end-line survey conducted towards the end of 2013 were used to supplement the data collected in 2012.

4.5 Data collection methods

Critical realism advocates for multi-method data collection for the generation of rich data that can excavate the causal mechanisms in a specific context (Easton, 2010). Correspondingly, case study research supports the use of a number of data collection methods such as documentation analysis, archival records, interviews, direct observation, and participant observation, as well as an examination of available physical artefacts (Yin, 1994), to generate contextually deep and nuance-rich accounts of lived experiences of the participants in their setting (Schultze & Avital, 2011).

In this study, data was collected using semi-structured interviews, focus group discussions, document analysis, participant observation and field notes. Data was collected using multi-methods to ensure triangulation and a rich data set that could test to confirm or refute the propositions for the study.

The documentation analysis helped with the understanding of the MSSM intervention, establishing the objectives of the project/intervention, the operations and processes involved in the use of the mHealth system, and expectations of the project outcomes from different perspectives, in addition to the actual outcomes. This was used in the first phase of the study with the aim of explicating structures, events, outcomes, and the context of MSSM.

The second phase of study used interviews, participant observation, and field notes to substantiate the processes and interactions or associations among the mechanisms identified in the retroductive process, and how they manifested in the context of MSSM under the influence of conversion factors. The interviews were conducted with a wide range of stakeholders for the project to achieve completeness. Finally, focus group discussions were conducted with the users of MSSM intervention to further get in-depth understanding of the mechanisms at work and the underlying structures that caused the outcomes.

4.5.1 Document analysis

The initial phase of data collection involved collecting and analysing documents relating to the MSSM project. Some of the documents were collected from the Internet i.e. the website for the project. Other documents were accessed directly from the project. Health facility records and documents were also reviewed, checking for evidence of the impact of MSSM on maternal morbidity and deaths. The documentary sources used in this study, shown in Table 4-3, helped with development of the theoretical base and the propositions for the study.

Table 4-3: Documents used in the study and their sources

Type of Documents	Source	Number of documents
Project Profiles	Implementing agency and donor website	2
Project briefs	Implementing agency and donor agency	3
Projects reports	Implementing agency, donor agency, and their website	9
Project evaluation reports	Donor agency & Implementing agency	4
Tips, reminders and advice given to women	Implementing agency	3
Meeting minutes	Implementing agency	3
Online articles on MSSM	Internet	1
Antenatal registers	Health facilities	24
Delivery reports	Health facilities	18

Project reports, briefs, and minutes of meetings were reviewed; they provided a good window to the background and the main objectives of the intervention, and also highlighted some activities and processes involved in the women’s use of the intervention.

Document analysis was primarily used to gain understanding of mHealth in the context of Malawi and the MSSM intervention, which helped with narrowing the focus of the research to analysing the processes that produced outcomes for the women using the intervention. Again, some of the documents used suggested some questions that needed to be asked and the situations that needed to be observed to understand these processes (Bowen, 2009). Documentation analysis was also used to verify findings or corroborate evidence from the participants’ interviews; it strengthened the researcher’s interpretation of the respondents’ subjective accounts. Where the documentary evidence was contradictory rather than confirmatory, these variations revealed interesting avenues of further analysis. As such, the documentation analysis enhanced objectivity in the interpretation of the interview data through the corroboration procedure.

4.5.2 Sampling

The ideal standard of a qualitative sample size allows interviewing until redundancy of concepts, a situation where no new concepts or themes are any longer emerging (Trotter II, 2012). To achieve this, a number of sampling strategies were used to recruit participants who would provide relevant information to the study; most of them hinged on purposive sampling. Purposive sampling involves selecting the types and numbers of cases strategically

while focusing on the main objectives of the study and also being mindful of the resources available to conduct the study (Palys, 2008; Patton, 1990). In the planning stage, stakeholder sampling (a type of purposive sampling) was used in deciding who to interview for triangulation and rich data generation (Myers & Newman, 2007). Stakeholder sampling strategy is useful in evaluation research as it identifies stakeholders who are involved in the activities concerning the phenomenon of interest, or affected by it in one way or another (Palys, 2008). The sample included all types of stakeholders involved in the operations of the MSSM intervention, as depicted in Table 4-4.

Table 4-4: Sample (key informants) for the study

Interviews		
Designation	Agency	Number
Intervention users/beneficiaries (Mothers)	Community	12
Husbands to users	Community	4
Community volunteers	Community	4
Health surveillance assistants	Community	4
Health personnel	Community health facilities	4
Project implementers	MSSM project	2
Ministry of Health (government) representative	District Health Office	1
Donor representative	International development agency	1
Focus Group Discussions		
Intervention users (Mothers)	Community	14 (Two groups of seven women interviewed in two different areas)

The researcher was granted access to the project database, which had records of all the women registered in the intervention (about 3 000), the Community Volunteers, and the Health Surveillance Assistants (HSAs). Random sampling was used to select about 100 mothers using the intervention, those who owned mobile phones and those who did not; and 50 Community Volunteers. Then the researcher called them on the phone to find out about their personal details and location. Those without mobile phones were reached through Community Volunteers in their respective areas. Further, maximum variation sampling was used to get participants of different ages, marital status, and tribes among other variables so that we could get participants of diverse background and characteristics. The MSSM project was being piloted in four catchment areas out of the 14 in one district of Malawi. A catchment area is an area from which health facilities' patients or healthcare consumers are drawn.

The study had 32 respondents in one-to-one interviews and two groups of seven women for the focus group discussions. Table 4-5 summaries the respondents for the one-to-one interviews.

Table 4-5: A list of respondents for semi-structured interviews

ID No.	People interviewed	Institution	Focus of the interviews
Mother-1	Mother 1	Community A	Experience with MSSM
Mother-2	Mother 2	Community A	Experience with MSSM
Mother-3	Mother 3	Community A	Experience with MSSM
Mother-4	Mother 4	Community B	Experience with MSSM
Mother-5	Mother 5	Community B	Experience with MSSM
Mother-6	Mother 6	Community B	Experience with MSSM
Mother-7	Mother 7	Community C	Experience with MSSM
Mother-8	Mother 8	Community C	Experience with MSSM
Mother-9	Mother 9	Community C	Experience with MSSM
Mother-10	Mother 10	Community D	Experience with MSSM
Mother-11	Mother 11	Community D	Experience with MSSM
Mother-12	Mother 12	Community D	Experience with MSSM
Partner-1	Partner 1	Community A	Experience with MSSM
Partner-2	Partner 2	Community B	Experience with MSSM
Partner-3	Partner 3	Community C	Experience with MSSM
Partner-4	Partner 4	Community D	Experience with MSSM
CV-1	Community Volunteer 1	Community A	Experience with MSSM
CV-2	Community Volunteer 2	Community B	Experience with MSSM
CV-3	Community Volunteer 3	Community C	Experience with MSSM
CV-4	Community Volunteer 4	Community D	Experience with MSSM
HSA-1	HSA 1	Local health facility A	Experience with MSSM and implementation
HSA-2	HSA 2	Local health facility B	Experience with MSSM and implementation
HSA-3	HSA 3	Local health facility C	Experience with MSSM and implementation
HSA-4	HSA 4	Local health facility D	Experience with MSSM and implementation
HW-1	Midwifery nurse	Local health facility A	Experience with MSSM and implementation
HW-2	Medical assistant	Local health facility B	Experience with MSSM and implementation
HW-3	Midwifery nurse	Local health facility C	Experience with MSSM and implementation
HW-4	Midwifery nurse	Local health facility D	Experience with MSSM and implementation
SH-1	District safe motherhood coordinator	District hospital	Experience with MSSM and implementation
SH-2	Project outreach coordinator	Implementing agency	Implementation and evaluation of MSSM
SH-3	Project manager	Implementing agency	Implementation and evaluation of MSSM
SH-4	Donor representative	International development agency	Implementation and evaluation of MSSM

The husbands of the women using the intervention were included in the sample for the study, because it was felt that they could give some insights on how their wives were using

the intervention and the results they were able to observe from the intervention use. Literature has shown that husbands play a key role in maternal healthcare, from deciding what the wife should or should not do, to giving permission for the wife to use healthcare services or not (Lori & Bolye, 2011; Seljeskog et al., 2007).

The Community Volunteers who served as point of access and usage for MSSM provided some insight on the operations of MSSM. The HSAs and the health workers were mainly interviewed in order to understand the implementation of MSSM at local health facilities and the perceptions of the community on MSSM from their point of view. The interviews with the other stakeholders from government, implementing agency, and development agency focused on implementation, evaluation, and impact.

4.5.3 Interviews

4.5.3.1 Interview instrument design

The research instrument was designed based on CA framework covering concepts necessary for a realist evaluation. CA guided the interviews and helped to focus the conversations on the main objectives of the study, in addition to generating rich data, since frameworks assist participants to articulate and interpret their experiences in relation to the objectives of the study (Schultze & Avital, 2011). The interview guide had open-ended questions to solicit in-depth contextual participants' accounts of their world and experiences on the subject matter, and how they make sense of them and interpret them, as it allows for long answers, reflection, opinions, and feelings. With this method, the decision of important and relevant things to talk about on the subject matter was at the respondents' discretion, and it gave them a space to express themselves properly. This gave the researcher room to listen, prompt, encourage, probe for further explanation, and direct the conversation in a way that would generate rich data (Myers & Newman, 2007; Schultze & Avital, 2011).

The instrument was piloted before commencing the actual data collection. Data from the pilot study was transcribed and discussed with the researcher's supervisor and some colleagues. Changes were made in some areas that were not clear. The final questionnaires that were used as a guide for the interviews are provided in Appendix D.

4.5.3.2 Interview process

The researcher had no relationship with the implementing agency or any of the participants interviewed. The researcher merely went to the project as a student seeking to do research on the intervention. Being Malawian and able to speak the local language made it easier to conduct and facilitate interviews, even with the locals in remote areas. When interviewing in remote places, in the villages, the researcher had to observe the traditional local way of doing things, to fit in with the locals. This helped the respondents to be at ease with her and be able to express themselves freely. All the interviews except one were carried out in person. The one interview, with the donor representative, was on the phone through Skype, because the respondent was not in Malawi during the period of data collection.

At the beginning of each interview, the following four steps were conducted:

1. An introduction letter was presented to the interviewee if they had not already received one.
2. Permission letters to carry out the study from the Ministry of Health (MoH), the implementing agency of MSSM intervention, and University of Cape Town were also presented to the respondents.
3. Consent was sought from the participants; they were assured that their identity would be kept confidential and would not be disclosed in any discussion or reports produced.
4. The aims and objectives of the study and the importance of their participation and their responses were explained to the respondents in detail.

The interviews were conducted either in Chichewa (the local language) or English, with a duration ranging from 45 to 90 minutes each. Chichewa is a national language; all interviewees, with an exception of one from the donor agency, spoke and understood Chichewa. During the interviews, non-verbal and non-communicable observations were noted. For each interview, the researcher took notes. The interviews took place in the respondents' work premises, homes or nearest health facility.

During interview sessions, the research guide was used in order to cover all relevant factors for each case. Being a qualitative study, some themes and interesting concepts emerged and the researcher used the mirroring technique to probe deeper into the matter for more disclosure. The researcher also used 'off-the-sheet-questioning' in trying to get to the root of some issues. The researcher was flexible in making some changes to the questionnaire based on the emerging themes, so as to intensify the in-depth interview with the hope of excavating more of the underlying mechanisms and structures, and making sense of their interactions and relationships.

4.5.4 Focus group discussions

Two focus group discussions (FGDs) were conducted with two groups of seven women each at health facilities of two catchment areas. These discussions were conducted after the one-to-one interviews as a final method of testing and confirming the theories that developed in the course of the study, since FGDs have been said to be good for checking tentative conclusions in evaluation research (Marshall & Rossman, 2006). In addition, FGDs have been found to be helpful in researching sensitive subjects such as maternal care (Goodburn et al., 1995). FGDs were considered a good forum since they encourage reflexivity and participants are able to react and respond to each other's remark, which could yield more insights (Kaplan & Maxwell, 2005).

The health facilities provided a spacious room where the discussions were conducted, and the researcher created a relaxed and supportive environment for the women to feel free. The researcher used an interview guide to ask focused questions and facilitated the discussions by encouraging participation and expression of differing opinions and points of view (Marshall & Rossman, 2006). The discussions were audio-recorded and an assistant took notes of the discussions as well. The discussions lasted two hours on average each.

4.5.5 Participant observation and field notes

In this study, participant observation was employed in the following instances:

1. At the call centre, observing how the mothers' calls were handled by the hotline staff, and the kind of help being sought and provided
2. In the community, the researcher joined the community outreach team to various sites and observed in meetings they had with the mothers at ANC, and in meetings with the Community Volunteers
3. At the health facilities during ANC and just general operations

At all times, field notes were taken. The field notes helped with data analysis and also served as reminders of some situations. The observations and the field notes yielded some useful insight on components that generated some behaviours and actions relating to the mHealth use.

4.6 Data analysis

Data analysis for the study was done in three phases according to the stages of the research design:

1. Documentation analysis using inductive approach
2. Abductive and retroductive analysis using theories and empirical evidence from phase one and literature review
3. Thematic analysis using a conceptual framework developed from phase two

In all the three phases, the analysis followed the sequence proposed by Miles and Herberman (1994): data reduction, data display, and conclusion drawing/verification.

The first phase of data analysis focused on documentation analysis. The study employed the general inductive approach for analysing qualitative data with the aim of describing the context and underlying structures of the experiences and processes of MSSM (Thomas, 2006). The researcher familiarised herself with the data; the documents were read several times to identify themes, which were further grouped into categories and meaningful themes for a description of MSSM intervention.

In the second phase of analysis, CA framework was used to reinterpret mHealth use in maternal health. Findings from the analysis in phase 1 and prior knowledge from literature were used to redescribe mHealth use in maternal health, using the tenets of CA. The analysis further employed abstract reasoning in the process of identifying necessary conditions for mHealth outcomes (Danermark et al., 2002; Eastwood et al., 2014), where a number of theories were used to conjecture how mHealth outcomes in maternal health are produced.

In the third stage, data was collected using CA framework; however, the analysis was done based on the conceptual framework developed by the author in phase 2, presented in Chapter 6. The framework incorporated other theories which supplement the explanatory power of CA in ICT4D evaluation. Data analysis started during data collection, this helped with getting more clarification and depth on some themes. The researcher familiarised herself with the data through transcribing all audio interviews and reading through the scripts repeatedly in order to gain an overview of the main themes discussed by the participants. The audio recordings that were in vernacular language were transcribed and translated.

Using the three steps for creating theory-driven codes (Boyatzis, 1998), a code book was developed using the theoretical concepts from phase 2, described in Chapter 6, and any further insights gained from the reading of the transcripts. The codes were particularised to the MSSM intervention empirical data and situation, and were tested for reliability using two scripts from the pilot study. The researcher involved her supervisor and a colleague in the reliability testing of the codes developed. Revisions were made accordingly until a consensus for that stage was reached, as reviewing and revising codes are an ongoing iterative process.

Thematic analysis and pattern matching techniques were employed all through the analysis in a highly iterative and integrated manner to code the data (Braun & Clarke, 2006). Atlas ti qualitative data analysis software package was used for coding data extracts from the corpus based on if the account or statement was related to MSSM as a capability input, capability for a pregnant mother, mechanisms (reasons behind how MSSM enabled the

capabilities), and the conversion factors. The codes were reviewed, refined, and organised into themes. Emerging themes were further categorised and sub-categorised into new concepts or those already developed. Similarly, field notes taken during observations were analysed using the same codes and themes as those used for respondents' scripts. Sample of the analysis table is presented in Appendix E.

4.7 Validity and reliability of findings

Validity in qualitative research entails rigour in the research design and the interpretation of data (Morse et al., 2002; Venkatesh, Brown, & Bala, 2013). Morse et al (2002) accentuate that validity should be explicit in all undertakings of qualitative research, and that it largely hinges on the responsiveness (approach, sensitivity, skills, and experience) of the researcher. In the same way, critical realism advocates for creativity, skill, and objectivity in all stages of its methodology for the development of credible causal theories. Bearing this in mind, the researcher started working on the initial steps towards validity and reliability in the planning stage of the study. Triangulation and other strategies, as detailed in the subsequent sections, were used to counteract the potential pitfalls of qualitative methods discussed in Section 4.3.

4.7.1 Triangulation

In the planning stage, while preparing for field work, the researcher talked to a number of experts in the field of ICT4D, health informatics, mHealth, and maternal health, to understand the terrain. Names of the experts, as presented in Table 4-6, are hidden for ethical reasons. The knowledge gained from these conversations helped with the development of research instruments and also gave the researcher some pointers to look for in the field. In the course of the data analysis phase, the researcher shared the findings with some of the experts to gain insight into their understanding and interpretation of the data, so that the study could incorporate interpretations from varied viewpoints (i.e. health, IT, business, and academic) for the potential explanations that best explicate the mechanisms of the MSSM intervention outcomes.

Table 4-6: Experts consulted in preparation for field work

Position	Agency	Field
Director	South African NGO developing mHealth solutions	mHealth
Director	International Implementing agency working in South Africa and Malawi	mHealth and child health in Malawi
Researcher	Technology for Emerging Markets Group, Microsoft	ICT4D, M4D
Professor and senior lecturer	Cape Peninsula University of Technology	Health informatics
Professor and Research Director	University of Eastern Finland	Health informatics
Professor and senior lecturer	University of Southampton	ICT4D, M4D
mHealth director and researcher	University of Southampton	M4D, mHealth
Senior research Manager	South African Medical Research Council	Health informatics
Head of Program Advanced Midwifery and Neonatal Nursing	Stellenbosch University, Nursing	Maternal health and mHealth

As discussed in Section 4.5.2, stakeholder sampling was used to select relevant stakeholders of the MSSM intervention as participants for the study. Data was collected using multi-methods such as documents, interviews, FGDs, participant observations, and field notes, with the purpose of getting data from different viewpoints, and also testing and confirming emerging concepts from different angles. In terms of theoretical triangulation, CA was supplemented with a number of social theories, resulting in a conceptual framework that was used for data analysis for the assessment and refinement of the mechanisms and their corresponding propositions. In addition, documentation analysis and feedback from the stakeholder groups were used to substantiate participants' narratives. These were compared to determine areas of agreement for confirmation, and those of divergence for further analysis.

The study further used the qualitative research in critical realism validity model by Zachariadis et al (2013), as presented in Table 4-7, to explicate the design, analytical, and inferential validity for the investigation

Table 4-7: Validity in qualitative research within the critical realism paradigm

Validity Type	Conventional Description	Critical Realism
Design Validity	<i>Descriptive validity:</i> Accuracy of events, objects, behaviors, and settings reported.	Explanations of mechanisms in action and the conditions with which they are interacting; appreciation of the field by identifying, prioritizing, and scoping boundaries of the study.
	<i>Credibility:</i> Results are believable from the participants of the research.	
	<i>Transferability:</i> Results can be generalized and transferred to other settings.	The idea that similar or related events that occur (or might occur) in other settings are caused by the generative mechanism that caused the actual events in the field.
Analytical Validity	<i>Theoretical validity:</i> Theoretical explanation developed fits the data.	Theory is used to help hypothesize about the mechanisms and provide explanations for the events that have occurred.
	<i>Dependability:</i> Researchers describe changes in the research setting and its effects on the research approach of the study.	This is an essential part of the retroductive process and identification of contingent factors.
	<i>Consistency:</i> Verifying the steps of qualitative research process.	Challenge and inform the terms of (quasi-)closure and process of ongoing inquiry in retroductive analysis.
	<i>Plausibility:</i> Findings of the study fit the data from which they are derived.	Whether data that is empirically available gives valid knowledge about the actual manifestation of the alleged generative mechanism in the field.
Inferential Validity	<i>Interpretive validity:</i> Interpretation of participants' views are accurate.	Findings from qualitative research can provide information about the mechanisms that cause the events at the empirical level.
	<i>Confirmability:</i> The results are confirmed by others.	

Source: Zachariadis et al. (2013)

4.7.2 Design validity

The researcher made sure that there was coherence between the main objectives or research questions, and the methods used for data collections. An iterative process between theory and the empirical situation was employed to make sure that the research question matched the method used, which further matched the data and analytical procedures used (Morse et al., 2002). These are discussed in detail in Sections 4.5 and 4.6. To ensure credibility, appropriate samples, consisting of participants who best represented the stakeholders of the MSSM and had knowledge of intervention, were selected for the study. Stakeholders who had interacted with the system or were affected by it in one way or another, were interviewed, so as to collect data on all aspects of mHealth use in the context of the MSSM intervention.

The findings in critical realism research are context specific; as such, transferability is concerned with the underlying mechanisms in action for a phenomenon of interest to occur. The mechanisms identified and explicated in critical realism investigation are believed to be present in any setting, whether activated or not. But the events produced by these mechanisms may differ from setting to setting, depending on the contextual factors.

4.7.3 Analytical validity

This chapter describes all the steps taken from planning, to data collection, to data analysis, with all the procedures used highlighted and justified for consistency. Memoing and reflectivity techniques were used to ensure objectivity in the analysis and interpretation of data. Writing memos throughout the analysis process helped with reflecting on the findings and eliminating some of the bias towards the researcher's personal beliefs. Triangulation of participants' accounts with evidence from documentation analysis enhanced objectivity of the researcher, as discussed in Section 4.5.1.

A detailed discussion on how data was collected and analysed is presented in Sections 4.5 and 4.6. The findings of the study and the causal explanations developed were grounded in the raw data. The themes used in the explanations were formed from the categorisation of codes attached to the data extracts in the corpus and, where necessary, the actual narratives from the participants were used to back up a point (see chapters 5 & 7).

4.7.4 Inferential validity

The interpretation of the data involved thinking theoretically (Morse et al., 2002) on the part of the researcher, thus confirming emerging concepts with new data. This led to excavating more concepts (on mechanisms, structures, and contextual factors) that needed to be corroborated in the data already collected, or more new data, so as to make sense of the interactions and relationships among mechanisms and contingent factors for the development of plausible causal explanations. Concurrent data collection and data analysis helped with testing and confirming some concepts, yielding clarity to the interpretation, which was enhanced through stakeholder group feedback and expert feedback on the initial findings.

This chapter presents a clear documentation of the research methods used in this study. As such, it could be conducted again in other settings for confirmability. However, as previously discussed, critical realism is concerned with the development of causal theories of the underlying generative mechanisms, which act differently in different settings, depending on their activation and contextual factors.

4.8 Ethical issues

Childbirth and pregnancy are sensitive topics in developing countries, Africa in particular, where people do not talk about them anyhow (Lori & Bolye, 2011; Maimbolwa et al., 2003). Talking about childbirth and pregnancy issues in open space, let alone to a stranger, is regarded as a taboo or feared, due to beliefs of witchcraft. With this understanding the researcher sought permission to conduct interviews with all participants when executing this study.

Permission to carry out the study was first sought from the following organisations:

1. The *implementing agency* of the MSSM intervention; agreement to the study was jointly offered with the development agency and the international donors for the project.
2. The study passed through an institutional review process at the *University of Cape Town*, by the Research Ethics Committee, for ethics approval.
3. *MoH in Malawi* was contacted since the study dealt with health consumers; permission to carry out the study in health facilities using the mHealth intervention, and with the health consumers, was issued by the *District Health Officer* of the involved district.
4. The study further went through another review process by the *National Health Sciences Research Committee of Malawi*.

After getting approval from all these institutions, the study was given a period of one year for field work. The University of Cape Town ethics approval document, introduction letter, and consent form are presented in Appendices A-C. All other documents pertaining to permission to carry out the study in Malawi could not be presented due to ethics, to keep the name of the project anonymous.

During the interview process, the consent form contents were explained to the respondents, and then the consent form was presented to the respondents to read it for themselves and sign, together with a witness. Those who could not read could call someone to read for them who, in the end, would sign as a witness. None of the participants was

forced to go through the interviewing process, they were informed of their rights and that they had total freedom to drop out of the study at any time, if need be. Two respondents refused to answer some questions for personal reasons.

The participants were further asked if the discussions could be audio recorded; all the participants agreed to this. The contents of the interviews and identities of respondents remained between the researcher and the respondent, thus the study upheld the notion of anonymity and confidentiality – even for public documents. The names of the implementing agency, the project, the district, and the catchment areas were hidden due to ethical reasons. The study used a pseudonym for the project.

4.9 Summary of the chapter

The methodological framework of the study has been outlined in this chapter. Taking into account the ontological and epistemological assumptions of critical realism, qualitative methods using a case study strategy were adopted and implemented within the critical realist research design with the purpose of excavating the mechanisms, and making sense of their relationships and interactions, together with contingent factors that caused the MSSM intervention outcomes for the women. The study focused on the mHealth intervention as the unit of analysis for the investigation.

MSSM intervention was selected as a typical case for the evaluation of the effects of mHealth on maternal healthcare consumers in developing countries, mainly because of the high MMR in Malawi that is caused by lack of information and fast communication channels among other things, resulting in delay for the women to access healthcare, consequently accounting for 15-20% of the deaths. Data was collected using different techniques, and analysed in three phases, using inductive, abductive and retroductive, and deductive inquiry methods. For validity and trustworthiness of findings, the researcher incorporated different strategies such as triangulation of different kinds, reflectivity, and memoing, to reduce biases and inconsistencies. Table 4-8 summarises the methodological approach for the study.

Table 4-8: Summary of research design

Research approach	As applied in this study
Research topic	A pathway through which mHealth outcomes are produced for maternal healthcare consumers in a developing country context
Philosophical perspective	Critical realism
Research strategy	Qualitative research methods, and case study
Research techniques	Documentation analysis, Semi-structured interviews, Participant observation, Field notes, and Focus group discussions
Unit of Analysis	MSSM (mHealth) intervention
Data analysis	Inductive approach Abductive and retroductive Deductive using a conceptual framework developed from Capability Approach Data analysis techniques: Thematic analysis and pattern matching
Timeline	June 2012 – December 2014

The following chapter discusses the context of MSSM intervention.

5 CASE DESCRIPTION

5.1 Introduction

The previous chapter presented the research methodology for the study. The aim of this chapter is to further explicate the structures, context, and outcomes of mobile technology use in maternal health in the specific milieu of the MSSM intervention as a case study. According to CR, this case description is done in layman's language in terms that would make it relevant and amenable to the concepts of a particular theory or theories, laying ground for the conjecturing of the mechanisms with potential to produce the outcomes observed (Danermark et al., 2002; Eastwood et al., 2014; McGrath, 2013). The chapter starts with a brief background of the MSSM project, followed by the objectives of the intervention and its core components. A theory of transformation under which the programme was operated is presented, followed by a description of the various stakeholders involved in the project. The chapter also describes the outcomes and implementation barriers of MSSM. Finally, an outline of key chronological events during the implementation of the MSSM that led to the empirical outcomes is presented.

This chapter contributes to some insight relevant to answering the research questions:

1. What are the effects of mHealth in maternal healthcare for women in rural Malawi?
2. How do contextual factors influence the realisation of mHealth outcomes in maternal healthcare for women in rural Malawi?

The realisation of the outcomes depended on the interactions among the MSSM, individual capacities and a myriad of structures, of which their causal powers gave rise to the outcomes. This exploratory study yielded insights for the explication of the structures, context, processes, and outcomes; laying the ground for the abstraction of the underlying mechanisms in the next chapter.

5.2 Context of the study

5.2.1 Profile of Malawi

The MSSM project is one of the initiatives implemented in Malawi to reduce the high MMR in an attempt to achieve the MDG5. The country profile of Malawi was briefly discussed in Section 4.4.4, covering some of the selected indicators shown in Table 5-1.

Table 5-1: Selected statistics of Malawi

Index	Value
Population	15.3 million people (51% females & 49% males)
Percentage of rural population	84% (52% females and 48% males)
Life expectancy	54.8 years (55.2years for females & 54.9 years for males)
Literacy levels	74.5% (67.6% females & 81% males)
Fertility rate	5.7
Maternal mortality	675 per 100 000 live births
GDP per capita	\$350
Fixed line teledensity	1.4%
Mobile phones teledensity	27.8%
Internet teledensity	3.5%
Access to electricity	9%

Source: ITU (2012), Malawi NSO & ORC Macro (2011), Malawi NSO (2012b), and UNICEF (United Nations Children's Fund) (2013)

Malawi is among the world's least developed and most densely populated countries located in Sub-Saharan Africa, south of the equator. Malawi ranks among the poorest countries in the world with a gross domestic product (GDP) per capita of about US\$350, with about 50% of the population living below the poverty line and a further of 25% in extreme poverty (Malawi NSO, 2012b; UNICEF, 2013). Malawi has a population of approximately 15 million people with about 84% living in the rural areas; as such, the country relies heavily on subsistence farming and selling of produce (Malawi NSO, 2012a; 2012b). In 2010, the economic growth rate decreased to 6.53% due to reduced agricultural output of maize and tobacco; however, government is making efforts to create more jobs and encourage foreign investment.

Malawi, like many developing countries, has also experienced an increase in the number of mobile phone subscribers, with a teledensity of 27.8% comparing to 1.4% for landlines (ITU, 2012). It is estimated that Malawi has 3.3 million mobile phone subscribers (ITU, 2011a). The subscribers are shared between two mobile operators, Airtel and Telecom Networks

Limited. The network coverage for mobile phones spreads across almost all the parts of the country including rural areas. There is a belief that, with such coverage, some of the public services may be provided using mobile phones (Mtingwi & Van Belle, 2013). However, the network coverage is still a problem in some remote areas. Further, there is still low mobile phone ownership especially in rural areas; and women are 21% less likely to own a mobile phone than men due to gender discrepancies just like in other developing countries (ITU, 2010).

Malawi is burdened with poverty and other challenges such as limited levels of infrastructural development; low levels of literacy; poor healthcare systems; relatively high HIV prevalence; and ultimately high overall mortality rates (Malawi NSO, 2012b). Delivery of maternal healthcare is also a challenge to the resource constrained government of Malawi, with problems ranging from critical shortages of health personnel; poor access to health services; poor quality of the health services; poor and inadequate health facilities; to unsafe socio-cultural beliefs and practices that encourage early marriages and impede deliveries at health facilities (Bowie & Geubbels, 2013; Ministry of Health [Malawi], 2005).

5.2.2 Maternal health in Malawi

The highest MMR in Malawi was recorded in the year 2000, at 1 120 deaths per 100 000 live births. Since then the MMR has been decreasing at a linear progression from 984 in 2004, 807 in 2006 and to finally 675 deaths per 100 000 births in 2010 (Malawi NSO & ORC Macro, 2011), as depicted in Figure 5-1. The current projection of MMR for the year 2015 stands at 435 deaths per 100 000 live births, but it is most unlikely that Malawi will meet the set target (Bowie & Geubbels, 2013).

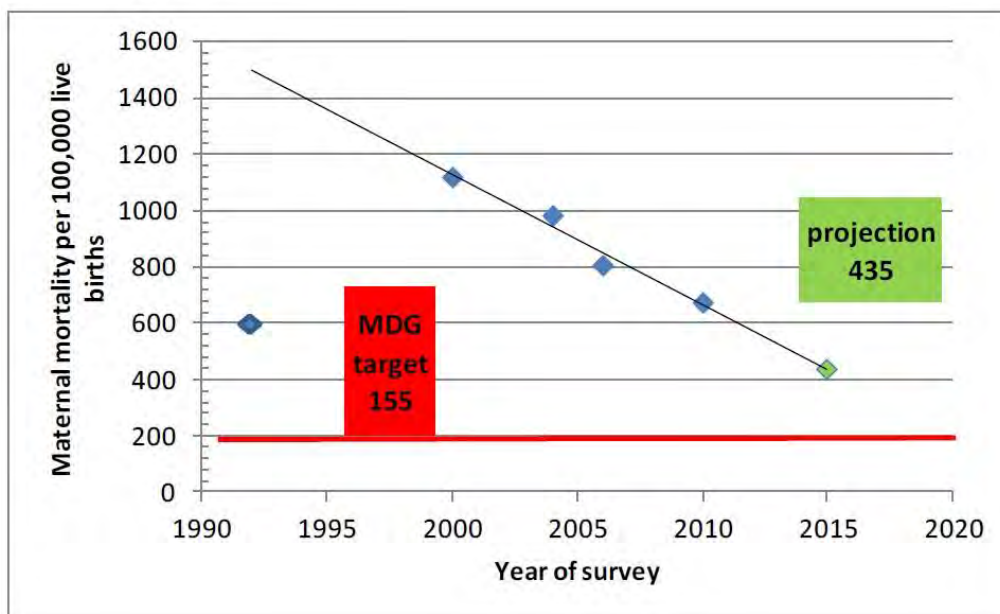


Figure 5-1: Trends and projections of maternal mortality in Malawi
 Source: Bowie & Geubbels (2013)

About 82% of maternal healthcare consumers reported having at least one problem in accessing healthcare services, such as finances, long distance to health facilities, lack of resources (especially drugs) in health facilities, and transportation to get them to a health facility in time for treatment (Malawi NSO & ORC Macro, 2011). Additionally, of 95% of women who received antenatal care from skilled attendants, only 12% had started ANC visits by the fourth month of pregnancy, as recommended; and less than 50% had received the recommended four or more ANC visits (Malawi NSO & ORC Macro, 2011). This makes it difficult to screen for problems that could culminate into complications. Further, only 71% had delivered from health facilities under the supervision of a skilled attendant. Home births in Malawi are common in rural areas at 26%, as compared to 13% in urban areas. Statistics on success or failure rate of home births are not available since they take place outside the health system and are unaccounted; however evidence shows that home births account for high rates of infections leading to maternal and infant mortality for women who decide to seek health services in the end (Bowie & Geubbels, 2013). Time and cost constraints to get to a health facility are obstacles for two-thirds of women, making delay a primary avoidable factor in 15 to 20% of maternal deaths (Bowie & Geubbels, 2013). In sum, Malawi is experiencing a sluggish decline in MMR.

The government of Malawi launched a Safe Motherhood initiative in 2012, with the aim of encouraging all women to utilise primary care services for prenatal and childbirth (Makoza et al., 2014). In addition, the government has adopted strategies to leverage ICT, including mobile phones to improve access to health information and health services, and ultimately improve health outcomes for MCH.

5.3 The MSSM project

5.3.1 Description of the project

The MSSM was part of a wider project piloted in three developing countries, two in Africa and one in Asia, with the aim of developing and testing different innovative ways that can overcome barriers to access and deliver maternal healthcare services. This wider initiative aimed to identify obstacles to maternal health service delivery, and foster the generation of creative ideas from local people that had potential to overcome barriers to healthcare for mothers and children. The best ideas would be developed into models and be implemented at district level, which would be subjected to rigorous evaluation so that the development agencies could learn from what works and what does not work, and why. The final goal was to analyse, synthesise, and disseminate the lessons learnt to inform policy and improve practice, in addition to scaling up successful models.

In accordance with the objectives of the wider initiative, the first stage of the MSSM project in Malawi was to assess barriers to maternal healthcare service in 2009. Among other challenges it was found that there were:

- Communication gaps between clients and community health workers
- Less participation and involvement of communities
- Long distances between communities and health facilities, exacerbated by poor transportation conditions and services
- Shortage of resources in health facilities e.g. drug supply
- Shortage of staff with poor human resource management
- Unmet expectations of clients for quality of care

Upon understanding the maternal health context in Malawi, a nationwide competition called 'Ideas to save life' was launched for local people to contribute new and innovative approaches to improve maternal healthcare delivery, utilisation and outcomes. Over 5 000 submissions were received. The ideas went through a rigorous review and selection process. Two ideas were successful in meeting the needs identified in the communities, and formed the foundation of the MSSM project. These ideas were:

1. A two way communication between clients and health personnel via a hotline for timely access to health information and advice
2. Use of mobile phone technology for tips and reminders on maternal health issues, together with a booking system and databases at health facilities to improve documentation

Prior to the implementation of the approaches identified, another assessment of key barriers to the implementation of maternal health services was carried out in 2011 among three districts of the three regions of Malawi. This was done to revalidate the initial findings so that they could be considered and incorporated in the planning and design stage of the intervention. The same barriers were found and corroborated; the only additional finding was that maternal health knowledge and the practice gap was wide in this particular district. Techniques on how the barriers could be mitigated were incorporated in the design of the intervention. MoH and other implementing stakeholders settled for one of the poorest performing districts in maternal health for the pilot project. The MSSM project was set up to test these two innovative ideas in a pilot project in this one district of Malawi.

The statistics of the chosen district showed that 92% of women with live births had received at least one ANC, and 76% of these women had had at least one problem in accessing healthcare, such as walking long distances to a health facility and finding long queues leading to a long waiting time (Malawi NSO & ORC Macro, 2011). This was due to health centres being sparsely situated with each serving a population of approximately 60 000. Table 5-2 summarises the maternal health profile of the piloted district.

Table 5-2: Maternal health profile of the piloted district

Index	Value
Women attending ANC in first trimester	35%
Women attending at least one ANC visit	92%
Women experiencing at least one problem in accessing healthcare	76%
Home deliveries	35%
Received postnatal check-up within 24 hours	33.8%
No postnatal check-up	52.9%

Source: Malawi NSO & ORC Macro (2011)

Less than 35% of women with live births had attended ANC in the first trimester; the delay in attending ANC was attributed to practices of testing women for HIV/AIDs during the first visit, and the requirement of husbands to accompany their wives on the first visit (Malawi NSO & ORC Macro, 2011). The district had about 32% of women still delivering from home, and only 33.8% of women with live births had had a postnatal check-up within 24 hours of delivery, with a total of 52.9% not having had a postnatal check-up at all (Malawi NSO & ORC Macro, 2011). The profile of the district and the evidence from the two maternal health barriers assessment qualified this district as a typical maternal health context to pilot the MSSM intervention, with the aim of improving access and utilisation of healthcare service for mothers and children.

5.3.2 Objectives of the MSSM project

Since over 84 % of the population in Malawi lives in rural areas, the project was piloted in the rural areas of the chosen district, starting mid-2011. The main goal of the MSSM project was to maximise healthcare access and utilisation by remote mothers who were faced by so many challenges such as walking long distances to access a health facility, resulting in delays in seeking care and unnecessary expenditures. The programme purpose was two-fold: to address demand seeking practices for the women, while improving the supply side capacity for service delivery. The objectives of the project were:

1. Improve the quality of maternal case management.
2. Improve maternal healthcare-seeking practices.
3. Increase community confidence in the health system.

Basically, the intervention aimed to increase maternal health knowledge at the personal level of a woman, to enable informed decision-making in maternal healthcare practices, both at home and at a health facility. It was envisaged that this would improve:

1. Community’s perceptions on the quality of maternal healthcare
2. Seeking of medical treatment at health facilities
3. Communication on maternal health issue in the communities, breaking the culture of secrecy surrounding pregnancy that leads to preventable complications and deaths

5.3.3 Components of the MSSM system

Initially, the MSSM was designed to run a toll-free helpline, Bulktool System for supplementary messages on pregnancy care, and to have an appointment booking system (which never worked out) for the pregnant mothers. Figure 5-2 presents as illustration of the MSSM system.

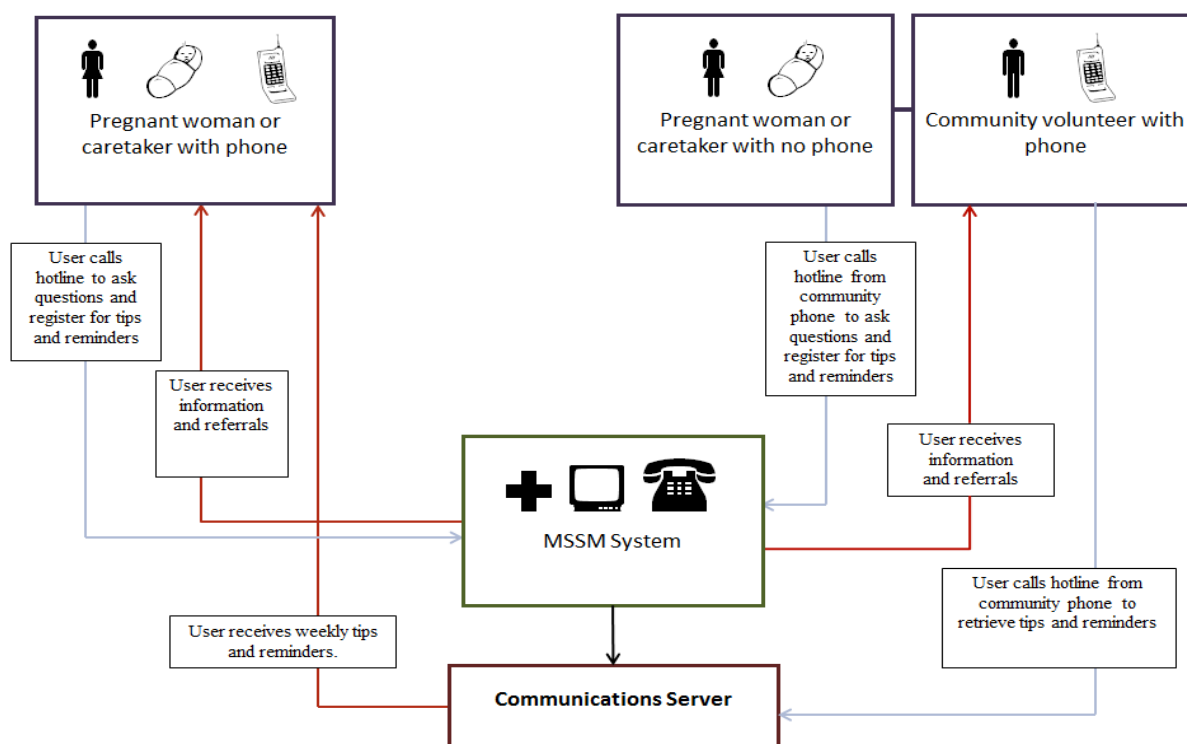


Figure 5-2: An illustration of MSSM Intervention

The toll-free line, commonly known as the hotline, operated on one mobile network, Airtel, using a short digit code that women could easily remember. The implementing agency

chose the Airtel network for MSSM services due to the operator having a larger subscriber base in Malawi and wider network coverage in the catchment areas where MSSM was piloted.

Women with access to mobile phones on the Airtel network could access the system for free, while phones on the MTN network needed to pay. The text messages could be delivered on both networks of the mobile operators in Malawi without any costs to the consumer. The main components of the projects were:

- a) Toll-free case management hotline
- b) Tips and reminders
- c) Booking system
- d) Community outreach, education and mobilisation on maternal health issues

5.3.3.1 Case management hotline

The toll-free case management hotline was based at the district hospital and was manned by qualified hotline workers (HLWs) who were trained in maternal health issues, using the maternal and newborn health community case management curriculum for CHWs. Some nurses working at the district hospital helped at the hotline on a part-time basis. The call centre was operational 12 hours every day, from 7 AM to 7 PM. To register for the intervention, women had to call the hotline, where their personal details were captured on the system. The women were told about their expected date of delivery (EDD) and the current stage of pregnancy, based on the date of their last menstruation. In addition, they received protocol-based advice on pregnancy care, nutrition, and sanitation.

The hotline provided health information to women who might have been out of reach of HSAs in the community or health centres; and health facility referrals to help prevent avoidable complication or emergencies. During the first call of registration, the women could choose whether to enroll for tips and reminders. After initial help with a health issue they called for, the women would be invited to join the system. Almost all the women accepted the invitation to receive the messages. The HLWs (hotline workers) gave the

women mini-training on how to access MSSM services, whether from personal phone or community phone.

5.3.3.2 Tips and reminders

Tips and reminders were a push service for automated messages for pregnant women through text or voice messages. The tips were personalised to the stage of pregnancy. Women were told what to expect (normal happenings) at a particular pregnancy stage and were also warned of danger signs not to be ignored. The reminders were for antenatal appointments and for prophylaxis medication and supplements taken during pregnancy i.e. malaria drugs and iron tablets respectively. The messages were provided in the two main vernacular languages of the pilot district. The voice messages could be retrieved from any phone on Airtel network for free upon authentication, using the EDD, while text messages were delivered straight to personal phones. The text messages were free for any network. The voice messages used an Interactive Voice Response (IVR) system, allowing the women to choose their preferred language and message for that week; the message could then be played. The IVR allowed the women to replay any part of the message. The voice messages were delivered once in a week while text messages were sent out twice in a week.

The messaging Bulktool system showed the audit trail of all the messages sent out. It would show the number of messages delivered to personal phones and the number of voice messages retrieved. In addition, it allowed easy modifications to the messages and their contents; as such it could accommodate emergent issues or changes to protocols, and recommendations. This made it possible for the enrolled women to receive one-off messages in response to community events or outbreaks.

5.3.3.3 Booking system

The booking system was introduced in two health facilities of the four under the pilot project, with the expectation of gradual roll-out to the rest. This component was designed to remind women of their ANC follow-up visits, with the aim of encouraging the women to attend ANC continuously. Previously, when women went for ANC, their details were captured in manual registers; this included the date of the next appointment. This was also

written down for the women in their health passport⁴. However, since this information was not on the first page of the health passport, and with low levels of literacy, women would fail to note the date, and consequently not turn up for a follow-up visit at the given date of appointment. To address this problem, the project provided hand-held devices (tablets) to the two health facilities, so that they could capture the same details entered into the manual registers on the tablets that fed into the system, for the system to be sending three reminders to the women regarding follow-up appointments.

The booking system was daunted by a number of challenges, was eventually deemed not feasible, and was abandoned. There was low mobile phone ownership among the women, and only 10-12% of the women knew their phone numbers to provide during the booking process to be receiving appointment SMS reminders. In addition, the capturing of information on the tablet added to the workload of already overstretched staff, since it was duplicating the same information put down in registers. Consequently, the booking system was terminated towards early 2012, and was replaced with small cards given to the women so that they could see where their next date of appointment was written.

5.3.3.4 Community mobilisation

The community outreach, education, and mobilisation component was devised as a mechanism for demand generation for maternal healthcare, and also to improve communication of maternal issues in communities. The implementing agency involved the community leaders and HSAs in their awareness strategy, in addition to recruiting about 400 Community Volunteers across the four catchment areas. The Community Volunteers were not the same as Community Health Workers (CHWs). Community Volunteers were individuals in the community with basic literacy who could use a mobile phone. Most of them were already involved in health promotion and were willing to volunteer their time to promote the MSSM intervention in their communities. Each village had at least one Community Volunteer.

⁴ Health passport – A booklet with a complete past health record of an individual, and can be used at any health facility in Malawi.

The main role of Community Volunteers was to provide phone access and usage for the intervention, and to demonstrate how to use the system. They also promoted the intervention by educating leaders and community influencers about the intervention, persuading them to encourage the community to use it. In addition, they were involved in community outreach, holding public meetings with the community. Community Volunteers visited the women in their homes for registration and follow-up on tips and reminders, so that the women could listen to their messages.

Due to poverty and low mobile phone penetration in Malawi (Makoza & Chigona, 2012), the project provided mobile phones to the volunteers in the villages as point of access and usage of the MSSM for women in the communities. However, the mobile phones were not durable and most of them did not work properly after one year of intervention, leaving most communities without access to MSSM services.

In early 2012, the monitoring and evaluation results showed that the communities lacked proper awareness of the intervention and this affected acceptance of the mHealth services. Thus, the implementing agency embarked on rigorous awareness campaigns involving the health personnel from the district hospital, the local HSAs, and Community Volunteers, holding a public meeting with some form of entertainment (e.g. a musician) and in the end addressing the community about the intervention.

5.3.4 Extension of services

Evaluation results after the first year of project operation revealed that women were starting to use the MSSM services late in their pregnancy and that most of these women were middle-aged. Most women would call for MSSM services when they had a problem with their pregnancy; that was when they registered. Women would see no reason to join the intervention if the pregnancy was progressing well. The average age of women calling the intervention was 26 years, but at that age in the rural areas one has quite a number of children already because the average age of mothers at first birth in Malawi is 19 years (Malawi NSO & UNICEF, 2008). Thus, the intervention was not capturing young women. In an attempt to get mothers to join and use the intervention early in their pregnancy and to

reach the young women and non-pregnant women, the project introduced a service for women in the child-bearing age group (WCBA) in September, 2012. The WCBA services included reproductive health and family planning advice, using the hotline and the tips and reminders supplementary messages. The aim was to develop a positive contact with the young and non-pregnant women so as to enable earlier access to health services.

5.4 Stakeholders of MSSM

A number of stakeholders involved in the MSSM project by the development agency, from the planning stage to implementation, were identified. These included organisations and individuals both at international and local level. The project notion started with philanthropists giving a donation to foster innovative ideas that could improve maternal healthcare in developing countries. A development agency which was awarded the donation planned and designed a framework on how local ideas on the use of technology to improve coverage and quality of healthcare for mothers could be used in three developing countries. The role of the development agency was to support maternal health by providing financial assistance and technical support on maternal health, project management support, monitoring and evaluation, and learning support. Three non-profit and non-government organisations (NGOs) with a presence in Malawi were subcontracted for the implementation of the project; these were:

- ICT for health NGO, tasked to design the mobile technology system and provide system support and maintenance
- International development NGO as the implementing agency
- Data management NGO, tasked to conduct rigorous evaluations to get lessons of what works and what does not.

Airtel was also involved; they supported the accessibility of the services at a reasonable cost.

Other stakeholders of the MSSM intervention included the government through the MoH, the district hospital and health centres, and health providers. Table 5-2 provides a list of stakeholders.

Table 5-3: Stakeholders of the MSSM project

Stakeholders	Roles
Philanthropists	Donation of good will
Development agency	Project management and technical support on maternal health at high level
ICT for Health NGO	Design the system and provide system support and maintenance
Implementing agency	Responsible for project operations and activities
Evaluating agency	Rigorously evaluated the concept
Telecommunication operator	Support accessibility of the services
Government (MoH)	Support the intervention
Hospitals & health personnel	Support the intervention and service delivery
HSA	Promote intervention in the communities
Community Volunteers	Promote the intervention Visit women of the child-bearing age group in their homes to promote the intervention even to their influencers, for registration and also follow-up visits with mothers who were already registered to help them listen to their messages Record keeping for all intervention use in their village Attend regular meetings with implementing agency and health providers to discuss operations and new strategies
Community leaders	Understand the benefits of the interventions and encourage their people to use it Draw policies that support and encourage the use of the intervention and improve health-seeking behaviour Select reliable individuals in their village to be volunteers for the intervention (Community Volunteers)
Village health committees	Promote the intervention Involved in the selection of community
Partners to the women	Give authorisation to the women to use the intervention Support the women in using the intervention and also in their action Promote the intervention
Elderly women	Influence women's decisions and actions Encourage/discourage the use of the intervention
Pregnant women	Register and use the intervention
Women in the child-bearing age group	Act on the information given Promote the intervention

MoH had interest in supporting the intervention at the district hospital and the health centres. The implementation agency needed permission from government and buy-in of the District Health Officer to pilot the project in the district. Health workers from the district hospital were involved in the training of the HLWs; the design and development of the maternal health content to be provided to the women; the quality assurance of the MSSM services by reviewing the messages and recordings of advice given to women by HLW to make sure that the women were receiving correct information. Some midwifery nurses worked part-time at the call centre. Health workers from the district hospital would also join the implementing agency staff when going for awareness campaigns in the community. Finally, the implementing agency provided the district hospital with reports at the end every month on the number of women seeking care on MSSM.

The implementing agency had a project manager for the MSSM intervention providing project management support on all project activities and operations. The project had two departments, the community outreach department and the MSSM system (the Hotline), each with a designated person responsible for its activities and tasks. The Hotline administrator was responsible for the system's operations i.e. reporting any problems arising, and also for quality assurance, including identifying training needs for the HLWs. The Community outreach coordinator was charged with sensitising the community about the intervention. He was responsible for the awareness campaigns, meetings with traditional leaders and other community influencers, the health workers in the health facilities, the HSAs and the Community Volunteers.

The implementing agency approached the community leaders as an entry point into the community. When permission was granted, the community leaders were tasked with choosing reliable people in their villages who could be entrusted with a phone and act as a point of access and usage for the community mobile phone, and also volunteer to promote the intervention in the village. The chiefs involved the village health committees, and together selected a Community Volunteer for each village. HSAs become involved in the intervention by virtue of being part of the village health committee, and also due to their affiliation with the health centre as the lowest level of government health workers. The role of HSAs in the project was not clearly defined; they involved themselves in the MSSM intervention just as they would with any other intervention on community health in their area.

The various community stakeholders mentioned above jointly promoted the intervention in the community by calling public meetings, targeting women and their partners, because culturally women could join and use the intervention only when their male partners allowed them to do so (Maimbolwa et al., 2003; Wilkinson & Callister, 2010). Some of the elderly women came to the meetings out of curiosity and many other were reached during house visit by Community Volunteers. Elderly women had interest in the project since young women in developing countries tend to listen and take advice from elderly women as they are custodians of maternal care systems in the community (Lori & Bolye, 2011; Maimbolwa

et al., 2003). The stake for the WCBA as beneficiaries was mainly in using the services to address their problems in the communities.

5.5 MSSM theory of change

A programme theory, illustrated in Figure 5-3, was postulated by the MSSM stakeholders on how the intervention would transform the communities. Based on the challenges and barriers to maternal healthcare identified in the pre-assessment and baseline study such as long distances to facilities, lack of timely information, distrust of the health system, and financial constraints (recall Section 5.3.1), it was hypothesised that the MSSM intervention would bring transformation by intervening with the existing maternal health context, and providing the pregnant women with:

- a. Timely preventative and curative advice on maternal health delivered within the community by a case management hotline and messaging service
- b. Reminders for ANC follow-up appointments using booking cards
- c. Community sensitisation on maternal healthcare services offered by MSSM and health facilities

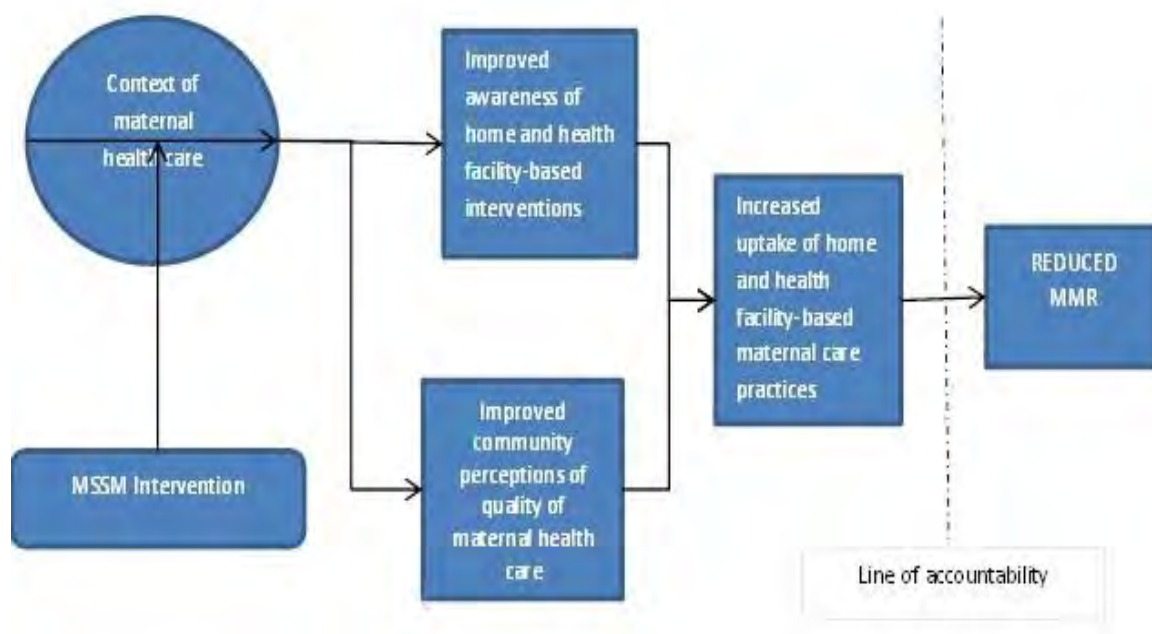


Figure 5-3: Theory of change for MSSM intervention

The theory conjectured that the interjection by the intervention would lead to a transformational process, starting from increased awareness of apposite facility and home-based interventions among pregnant women, as well as improved community perceptions of the quality of maternal healthcare. This would in turn increase the uptake of home- and facility-based maternal health practices, and ultimately reduce MMR.

However, the project failed to account for direct impact on the reduction of MMR due to a number of contextual factors, such as a number of other Safe Motherhood interventions working in the same area and, most importantly, the unavailability and poor quality of health services in the piloted area.

5.6 Outcomes of MSSM

The number of women using the intervention during the time of data collection was about 3 000, and between 450 and 600 calls were received every month. The calls ranged from advice seeking and minor ailments to major complications and emergencies that required referrals. On average, the women called the hotline three times during the whole pregnancy period, and they felt that MSSM gave them an opportunity to discuss issues in confidence and at length; this resulted in getting accurate advice and medical help specific to their condition and pregnancy stage. The weekly tips and reminders every week helped the women to understand the changes going on in their bodies and the development of the baby.

Through the use of MSSM, the women gained knowledge in maternal health. The advice and messages spanned around the topics of milestones in baby development, dealing with discomforts, danger signs in pregnancy, accessing healthcare, nutrition, and general household health practices. The intervention afforded the women an opportunity to receive quality, timely, reliable, and actionable maternal health information. This increased the adoption of home-based and facility-based practices depicted in Figure 5-4 among women.

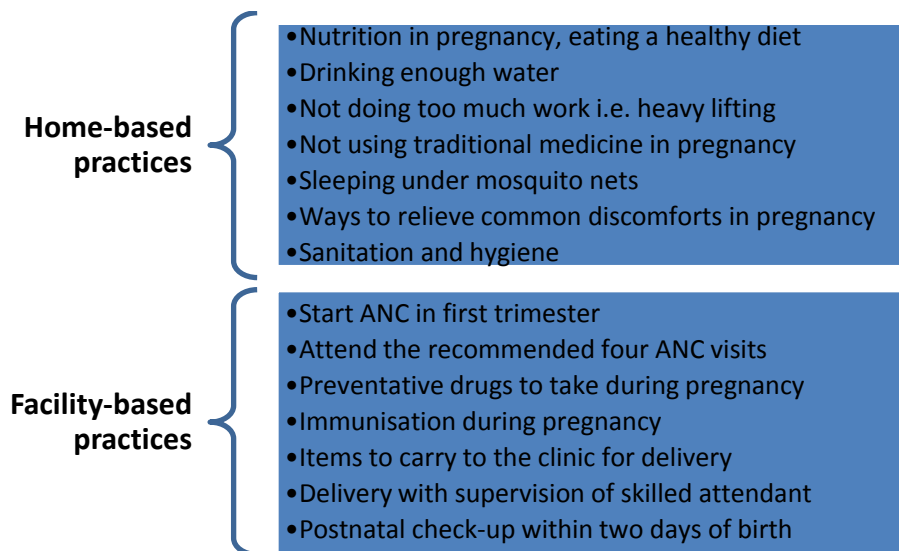


Figure 5-4: The home-based and facility-based practices learnt

The women were advised on how to prevent getting ill while pregnant, and on how to enhance their as well as the baby’s health. Furthermore, the estimated date of delivery helped the women to know the period around which they would give birth; with this they could prepare for childbirth.

MSSM empowered the women by giving them control on when and how they interacted with the health system. The women appreciated MSSM services as they could get medical help from home. This saved them walking long distances and/or standing unnecessarily in long queues at a health facility with trivial ailments that could be resolved at home. MSSM promoted seeking healthcare early and on time. It provided the women with an initial assessment of their health problem and advice on how to relieve it while at home. This allowed the women to continue with their daily activities without going to the clinic unnecessarily; saving them time and money that could have been used for transport. It also lessened the burden of health centre staff that is always overwhelming; “Only 25% of the callers required a referral”. If the condition required medical attention, the women were encouraged to go to the clinic, and would be advised on how to keep the situation under control. Some women would give post-referral health updates to MSSM using the hotline, and even report suboptimal experiences at health facilities. In some cases, the HLWs would follow-up on some clients to review how the advice was helping the women.

As discussed previously, most of the women joined the intervention due to ill health cues, and seeing that the health information given was working for their condition, helped in building trust in the system. Therefore, the women continued using the services and most of them adopted the health practices. However, contextual factors affected the realisation of the outcomes, and this resulted in varied outcomes for the women.

5.7 Barriers to MSSM implementation

The implementation of MSSM was faced with a number of challenges. Due to high cost of telecommunication in Malawi, the implementing agency had to cut down on some operations and messages. This was partly the reason why the booking system aborted. Poor network coverage and limited electricity access in most areas adversely affected the use of MSSM: “About 10% of calls were dropped every month due to network failure, and at time it cause system outage for hours”. Women had limited access to personal phones; nearly 60% of the women depended on community phones, most of which were not working by the end of the first year. Consequently the evaluation results showed that positive effects of increased maternal health knowledge and practice were greater for the women with a mobile phone in their household than those without. In addition, shortage of resources and poor infrastructure at health facilities were a challenge to provision of quality of healthcare service to the women. Such barriers were beyond the scope of the project but they had an impact on the effectiveness of the mHealth service.

5.8 Summary of the chapter

This chapter has presented the description of MSSM project. The project aimed to improve the quality and coverage of maternal healthcare, improving health-seeking behaviour and increasing the communities’ confidence in the health system. These objectives were believed to have been met through the improvement in the awareness of home-based and facility-based maternal health practices, and in the community’s perception of the quality of maternal healthcare. These two outputs led to the increase in the uptake of home-based and facility-based maternal health practices by the community. A number of different stakeholders with diverse stakes were interested and/or involved in the intervention. Table

5-3 summarises the chronology of key events in the MSSM intervention that led to the outcomes observed:

Table 5-4: Key events of MSSM intervention

Year	Event
2009	Assessment of barriers to maternal healthcare in Malawi
2009 -2010	Selecting innovative ideas from local people
Early 2011	Baseline survey & validation of the barriers
Mid 2011	Project roll-out
Early 2012	Booking system component stopped/ replaced by booking cards
Mid- 2012	Start rigorous awareness campaigns (the implementing agency staff)
Late 2012	Extend services to WCBA
Mid -2013	End-line survey

The outcomes show that the women had an opportunity to be empowered with health information through learning of the best practices in maternal healthcare, both home-based and facility-based practices. Receiving medical care while at home proved to be cost-effective as the women saved on money and time. Nevertheless, contextual factors were influential both in the access and use of MSSM services and the realisation of outcomes.

This chapter has elucidated on the structures, contextual factors and outcomes of the MSSM case. The introduction of the mobile technology system in maternal healthcare of the piloted area enhanced the health capability of the women through access to health information and health services. A health capability comprises of health functioning (outcomes) and health agency, thus “the ability to acquire and draw on health-related information, knowledge, and skills to preserve health and to develop a set of habits and conditions to prevent, to the extent possible, the onset of morbidity and mortality” (Ruger, 2010, p. 5).

Therefore, drawing from CA framework, the next chapter describes how the use of mobile phones may contribute to a health capability in maternal healthcare.

6 mHEALTH AND THE CAPABILITY TO BE HEALTHY IN PREGNANCY

6.1 Introduction

The previous chapter describes mobile technology use in the context of MSSM intervention. The aim of this chapter is to re-describe mobile technology use in maternal healthcare using Capability Approach. The chapter builds on the explication of outcomes, structures, and contextual factors in the case description and empirical evidence from literature review to identify the mechanisms that have potential to produce mHealth outcomes in maternal health, and determine what works for whom and in what circumstances. Propositions are conjectured for the development of a middle range theory on HOW, for WHOM and in WHAT context mHealth interventions give rise to the observed outcomes in maternal health. Finally, the study proposes a conceptual framework capable of explaining the underlying causes of mHealth outcomes for maternal health consumers.

The rest of the chapter is structured as follows: Section 6.2 gives a description of a health capability in maternal health. Section 6.3 re-interprets the use of mobile phones in maternal healthcare using the tenets of CA, highlighting how it enhances the health capability for maternal health consumers. A retroduction process was employed in the postulation of the mechanisms; this involved integration of other theories that augmented the explanatory power of CA as presented in Section 6.4. In CA, mechanisms are what provide an instrumental link between a capability and its associated outcomes (Smith & Seward, 2009). Thus, a conceptual framework for explaining a health capability for maternal health consumers through the use of mobile phones in developing countries is proposed in Section 6.5. Finally, Section 6.6 summarises the chapter.

6.2 Health capabilities in maternal healthcare

A health capability refers to the ability to be healthy and avoid any preventable morbidity and premature deaths (Law & Widdows, 2008; Ruger, 2006). It comprises of health functioning and health agency, i.e. an individual's ability to achieve health outcomes they value, and to act as agents of their own health (Ruger, 2010). In health agency, one's realised actions are compared with potential actions; and a health functioning is an

outcome of the action one takes to maintain or improve their health (Ruger, 2010). Being healthy in maternal healthcare denotes the physical, mental, and emotional wellbeing state of a mother during pregnancy and child birth, resulting in a full term pregnancy without problems, delivery of a healthy baby, and a healthy postpartum period in an environment that supports the physical and emotional needs of both the mother and baby (Freedman et al., 2007; WHO, 2009).

A healthy capability in maternal healthcare starts with good nutrition and a healthy lifestyle, thus reducing the risk of complications during pregnancy and childbirth, even before conception (WHO, 2009). Many of the complications in pregnancy and childbirth are unpredictable, they occur suddenly without cue symptoms, and all pregnant women are at risk of developing complications (Nanda et al., 2005; Prata et al., 2009). Therefore, for the women to be healthy in maternal healthcare, health facilities in communities need to offer Safe Motherhood services. This may be done with the support of local governments in collaboration with the international community. This strategy ensures that all women have access to health information and services for a safe pregnancy and childbirth (Freedman et al., 2007; WHO, 2009).

Women need to have access to information on health practices in pregnancy care and childbirth through education and awareness e.g. maternal nutrition. Further, women need appropriate prenatal care (i.e. a minimum of the four recommended ANC visits) so that they have access to preventative interventions, early diagnosis, and treatment of problems if they arise, and emergency care when needed (Adam et al., 2005; WHO, 2009). Since every delivery carries a risk of complications, maternal health emphasises delivery under the supervision of a skilled and trained health staff member to ensure that the women have access to life-saving emergency interventions at the time of childbirth (WHO, 1996). Further, the mother and baby need to be monitored at a health facility for a minimum of 24 hours to assess complications which may arise from labour and delivery (WHO, 1996; WHO, 2009). This postnatal period is also used for advising the new mother on family planning, and caring for herself and her newborn baby (Bowie & Geubbels, 2013).

In an ideal situation, a woman needs to have prior information on maternal health and reproductive health that would inform her choices of getting pregnant and delivering a healthy baby. Furthermore, pregnant women must have access to adequate maternal care, delivery under the supervision of a skilled midwife, and access to emergency obstetric care in pregnancy and delivery (Penn-Kekana & Blaauw, 2002; WHO, 2009). The health functionings of women in maternal health are:

- Going through a safe pregnancy
- Giving birth to a healthy baby

Since every pregnancy and delivery may have a complication, it is vital for expectant mothers to have access to health information and services. mHealth theory posits that the use of mobile technology in maternal health has the potential to increase access to health information and utilisation of healthcare services that improves maternal health outcomes (Huq et al., 2014; Oyeyemi & Wynn, 2014; Tamrat & Kachnowski, 2012). MSSM intervention theory specifically suggests that the use of mobile phones in maternal healthcare enhances accessibility to health information and services, resulting in increased awareness of health practices both at home and at health facilities, which in turn increases uptake of the health practices and reduces MMR. Therefore, these theories postulate that mHealth facilitates the realisation of the functionings of a healthy pregnancy and a healthy baby.

6.3 Contribution of mHealth to capabilities in maternal health

The aim of this section is to re-describe mHealth in maternal health from the consumers' perspective, using the explanatory theory of CA. This re-interpretation draws from the exploratory study findings in Chapter 5 and literature review, to highlight the structures and outcomes of mHealth in maternal health in a broader view of CA framework that helped with the abstraction of the mechanisms (Danermark et al., 2002; McGrath, 2013). Empirical evidence from literature and the description of MSSM intervention context and outcomes have shown a number of opportunities that can be created for women to achieve health outcomes from the use of mobile phones. However, it was noted that the actualisation of

such potentials was contingent on individual capacity, context, and the existing set of relationships (Lund et al., 2014a; Noordam et al., 2011; Osborn, 2013).

CA was deemed optimal for building an explanatory theory for the phenomena in this study, since it evaluates interventions according to what people are able to be or do, given a resource – a mobile phone system in this case; and how the realisation of outcomes is mediated by factors in a particular social system. Further, in evaluating technology use, CA goes beyond access and usage and focuses on meaningful use of ICT for people to live a life they value. Thus, after receiving the advice and messages from MSSM, what are the women able to do; i.e. do they seek medical help in time, as designed by the intervention? CA, coupled with critical realism, is capable of explaining *what* works about mHealth interventions in maternal health, for *whom*, in *what circumstances* and *why*. Further, CA is able to explain mHealth theory, starting from access and use of the mobile technology system to realisation of health outcomes.

CA framework by Hatakka and De' (2011) was used to conceptualise the use of mobile phones in maternal health in this study, mainly because of the importance it attaches to the role of technology in ICT4D projects, and the systematic evaluation of the empowerment process (or lack thereof) that takes place from the access and usage of the technology to the realisation of desired or unintended outcomes. Capabilities constitute structures with powers that provide wellbeing. In critical realism, these causal powers are the generative mechanisms that explain a casual pathway on how outcomes are derived (Martins, 2006). The activation of the causal powers is dependent on a woman's position in a role (i.e. wife or patient); and how that position shapes her choices in maternal healthcare (Kleine, 2010; Smith & Seward, 2009). For instance, a choice to act on the information received from MSSM was tied to individual capacity, resources, and socio-cultural values.

6.3.1 mHealth intervention as a commodity and the capabilities generated

mHealth intervention, like MSSM, is conceptualised as a commodity in CA. Commodities could be goods and services, whose characteristics generate the capabilities and opportunities that people can leverage. With ICT, it is not the technology itself that is

enabling, but the features within the technology (e.g. software applications), and the use of them that are enabling; and these should be the focus of the analysis (Hatakka & De', 2011). The system components i.e. the toll-free line and the supplementary messages, together with the mobile phone features used (voice calling, voice messages, and text messages) are what enabled the capabilities to access health information and health services in MSSM that impacted on the well-being of the women, as depicted in Figure 6-1:

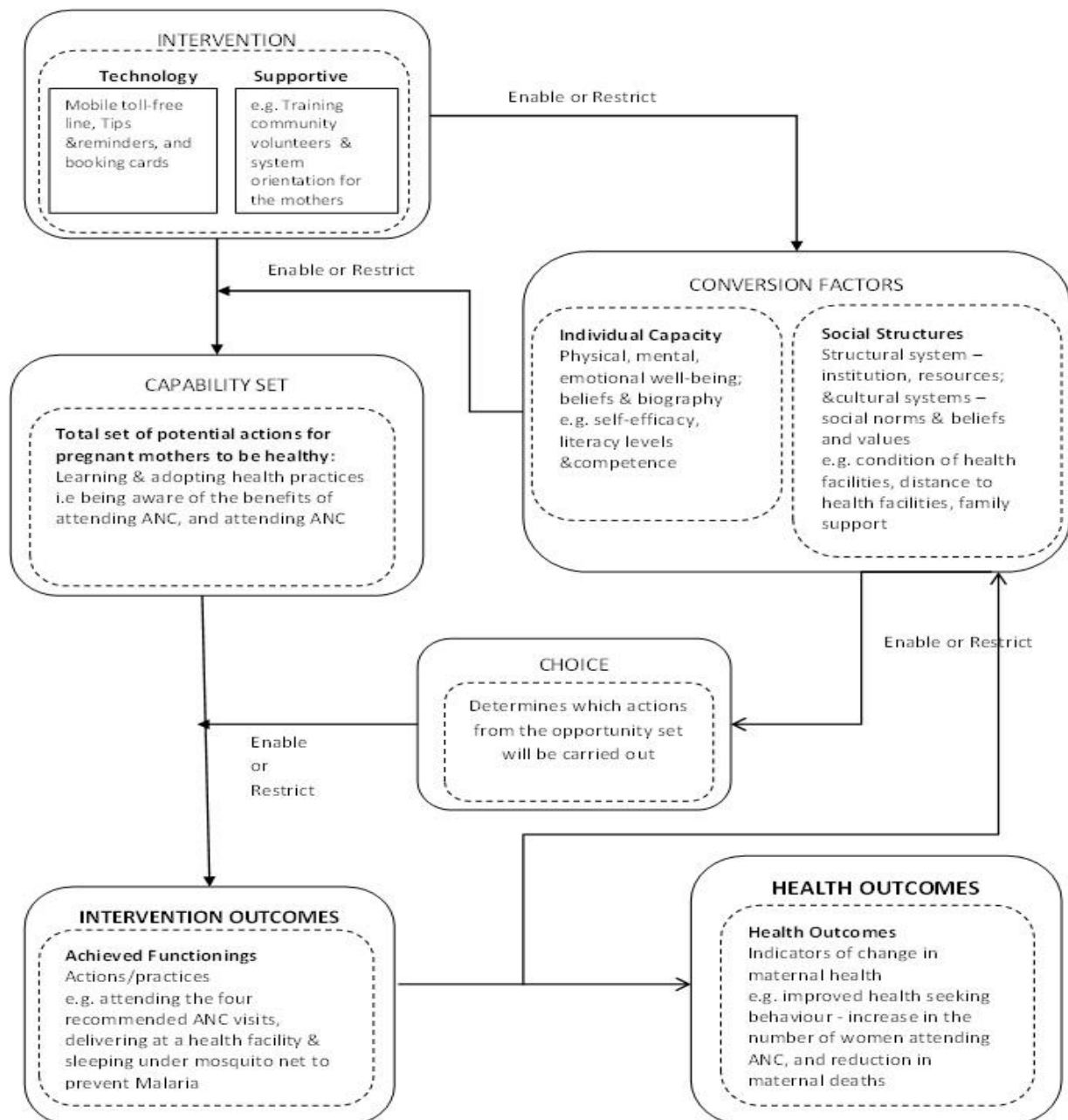


Figure 6-1: Conceptualisation of mHealth in maternal health using Capability Approach
Adapted from: Hatakka & De (2011) and Smith & Seward (2005)

The hotline provided health advice that helped the women's conditions and guidance on health practices that would enhance their health. The supplementary messages were informative, teaching the women how to keep healthy in pregnancy. Services from both the hotline and the supplementary messages had potential to increase the women's knowledge in maternal healthcare, especially on the dynamics involved in pregnancy development and childbirth, if the women chose to use it. The ubiquitous nature of mobile phones allowed the women to have access to MSSM services from anywhere between the operational time of 7AM and 7PM. This afforded the women instant access to health information and services from home without walking long distances to a health facility, which they found convenient.

The use of CA in studying ICT intervention takes into account supporting structures that make it possible for the intervention to work, such as training of users and community mobilisation through Community Volunteers, as a constitutive part of a commodity. Thus, the training of the Community Volunteers; the degree of support that the volunteers gave to the women; and the degree of support from the implementing agency, contributed to the generation of the capabilities. The MSSM intervention in its totality was a means for the women to have choice and achieve well-being in maternal health and life in general (Verkerk, Busschbach, & Karssing, 2001).

Insights from MSSM access and usage as a commodity that provided health information services to the women, revealed the processes through which the women engaged in activities that led to observed outcomes in maternal health. The empirical evidence shows that there is no direct connection between ICT and improved well-being (Gigler, 2011). The impact of ICT on well-being can only arise when there is meaningful use of ICT that improve people's informational capabilities, such as transforming the information capital of an individual, resulting in enhanced human and social capabilities to make strategic life choices to live a life that one has reason to value. For instance, in MSSM, the increase in maternal health knowledge from mHealth services led to changes in health practices that had a positive impact on maternal outcomes for some women. According to Gigler (2011, pp.7-8), enhanced informational capabilities refer to:

1. A person's ability to use ICT in an effective manner (ICT capability)
2. A person's ability to find, process, evaluate, and use information (information literacy)
3. A person's ability to effectively communicate with family members, friends, and professional contacts (communication capability)
4. A person's ability to produce and share local content with others through the network (content capability)

In the case of MSSM, the intervention engendered capabilities to do with information literacy and communication that further enhanced the women's capability to be healthy. The women had an opportunity to access health information and could communicate with health workers using mobile phones. The knowledge gained from these opportunities either relieved their condition or encouraged them to seek medical attention on time if acted upon. The actualisation of the opportunities generated by mHealth can be theorised as states and activities that the women engaged in to achieve the health functionings. This process was influenced by contextual factors pertaining to agency, structure, culture, and relations that were either enabling or constraining.

6.3.2 Conversion factors

Fundamental to CA is the recognition of human diversity. People are different in personal characteristics such as physical make-up, particular talents, and proneness to illness; also in external circumstances such as ownership of assets, social background, and environmental predicament (Sen, 1999, as cited in Zheng & Stahl, 2012). These differences affect the way an individual converts the opportunities generated from a particular commodity into achieved functionings. The contextual factors surrounding the MSSM intervention could be described as conversion factors. That is the reason why the women having access to the same MSSM services benefitted differently. CA advocates scrutinise the context in which social interactions are taking place; whether the circumstances in which people choose from their opportunity sets are enabling and just (Robeyns, 2005a). The extent to which capabilities can be generated from ICT, and the realisation of the functionings, is influenced by the three groups of conversion factors: personal, social, and environmental, which have

been categorised as individual capacity and social structures in Figure 6-1, adapted from (Hatakka & De', 2011; Smith & Seward, 2005). Table 6-1 illustrates some examples of conversion factors that manifested in MSSM.

Table 6-1: Examples of conversion factors in MSSM

Category	Examples
Personal factors	Literacy level Gender IT competencies etc.
Social factors	Income status Social network and support Socio-cultural beliefs etc.
Environmental factors	Distance to health facilities Poor transportation system Lack of resources at health facilities etc.

Personal characteristics, such as mental and physical condition, literacy, and gender influence how a person can convert the characteristics of the commodity into a functioning (Sen, 1992). By virtue of being female, women have low positions in society, especially in rural areas of developing countries (Lori & Bolye, 2011). This affects their literacy, exposure to accurate information, and decision making, even at household level. Even in MSSM intervention this was evident, most women did not have basic IT skills even to operate a mobile phone, which is a basic requirement in mHealth interventions. Low literacy also affects understanding and interpretation of the advice or messages received (Osborn, 2013).

Characteristics of social settings constitute social factors, which could be social norms (e.g. role of women, rules of behaviour, materialism, religion), social institutions (e.g. rule of law, political rights, public policies), and power structures (e.g. hierarchy, politics) (Zheng & Walsham, 2008). Good examples of power structures in MSSM could be the presidential initiative in maternal health in Malawi, and the involvement of the local leaders that supported the utilisation of both MSSM services and health facility services. The culture of women relying on their partners and elderly people for important decisions that concern their lives in developing countries usually hinders utilisation of mHealth and maternal healthcare (Noordam et al., 2011; Tamrat & Kachnowski, 2012). Social networks and support, especially those of family, are crucial, as they influence choices of a pregnant mother through peer pressure, based on cultural norms and values (Kyomuhendo, 2003).

Environmental characteristics such as climate, infrastructure, resources, and public goods also play a very important role in the conversion from characteristics of the commodity or services to the individual functionings (Alsop & Heinsohn, 2005). Some of the technological barriers included:

- Low mobile phone ownership and phone availability
- Most phones were usually unavailable due to lack of electricity in the rural areas
- Poor network coverage

Some users of MSSM could fail to go to the clinic despite receiving an advice to seek medical care urgently, due to long distance to a health facility, and because they could not walk in their condition of pregnancy. Poor transportation systems in rural areas and lack of transport money exacerbated the challenges in seeking medical care. Further, poor health facility infrastructure and lack of resources at health facilities deprived some of the women of a health capability in maternal health.

There is always interplay among the conversion factors e.g. a social custom can affect personal factors, which could affect the use of ICT in the end. For instance, the norm of keeping girl children at home to do domestic work contributes to high rates of illiteracy and lack of IT skills among women (Alsop & Heinsohn, 2005). Further, conversion factors are constantly changing due to agency and structure interactions, resulting in a dynamic relationship among the intervention, conversion factors, and the achieved functionings.

The exploitation of commodities, such as technology, certainly contributes not only to social conditions but also to personal characteristics which, in turn, feedback to conversion factors and decision-making mechanisms. Therefore, commodities are important for their contributions to both individual capabilities and to conversion factors (Zheng & Walsham, 2008, p.227).

6.3.3 Health functionings

MSSM was an alternative source of maternal health information and services for the women. Seeing the information working in their lives motivated these women to continue

using the system. In exercising their health agency, the women engaged in a number of actions, some of which are presented in Table 6-2.

Table 6-2: Sample actions that the women engaged in to achieve health outcomes

Actions leading to health outcomes
Learning home-based and facility-based health practices
Feeling secure about their pregnancy
Seeking healthcare services in good time
Managing complications before getting to a health facility
Plan and prepare for childbirth
Giving birth at a health facility
Having postnatal check-ups

Health functionings being outcomes from actions taken to be healthy (Ruger, 2010), these included awareness of home-based and facility-based health practices; improved health-seeking behaviour since women learnt not to ignore any illness cues in pregnancy, and were encouraged to seek medical care; patient satisfaction of the services provided on the MSSM but not at health facilities due to having adequate resources almost all the time.

The women were empowered with health information and had a sense of control over their health, resulting in feeling secure about pregnancy. They had control on when and how they interacted with the health system. MSSM increased their options for maternal health information and services. Gaining health knowledge improved patient-provider communication in frequency and coherence of dialogue.

Access to ICT like MSSM intervention is not an end to human development, but rather a means through which people achieve desired goals (Grunfeld et al., 2011). The findings demonstrated the opportunities that were enabled for the women and how contextual factors mediated the utilisation of the opportunities into different functionings. The enhanced capabilities were both the primary end i.e. intervention outcomes, and also the principal means to development (Robeyns, 2005a). For instance, being healthy during pregnancy would make it possible for a woman to engage in work activities to provide for her family.

6.4 The mechanisms for mHealth outcomes in maternal health

This section aims to identify mechanisms inherent in the capabilities with potential to produce mHealth outcomes for maternal health consumers. The starting point in maternal health is outlining the health functionings the women achieved. Literature and the findings from the MSSM case have shown that mHealth outcomes on the part of the consumer include improved patient-provider communication, patient satisfaction, patient empowerment, improved health-seeking behaviour, all resulting in healthy pregnancy and a healthy baby (Lund et al., 2014a; Noordam et al., 2011; Tamrat & Kachnowski, 2012). Since mechanisms provide an instrumental link between a capability and its associated outcomes, a thought operation (retroduction) was used to identify the necessary conditions that produced such outcomes (Smith & Seward, 2009; Smith, 2006). For analysis, the intervention was divided into three components: MSSM technology, women as health agents, and the health system. This analytical resolution helped to understand what was distinctly necessary about the components and also about their interactions that contributed to the mHealth outcomes.

For the *technological part*, the themes that emerged to be essential were accessibility, usability, service convenience, and system affordance. As discussed in Chapter 5, MSSM afforded the women immediate access to health information, and they found the services convenient as they got help from home, and could gain knowledge on how to manage a complication to keep matters under control on the way to a health facility. In addition, the messages from the system afforded the women an opportunity to learn new health practices in maternal health as well as health in general. For the women to exercise agency based on the information received, decision-making mechanisms were involved to actualise the information.

Women as *agents* of their maternal health have a choice to utilise the opportunities generated by the intervention. The choice lies in selecting the activities they would want to engage in to achieve health outcomes. Thus, acting on the information received through mHealth services requires the women to engage in different activities to achieve health outcomes, for instance, going to the clinic to access prenatal service.

The *health system* is solely responsible for provision of quality maternal health services to the women, which is consistent with the information from mHealth services. There is need for complementary maternal health resources at health facilities in developing countries (Noordam et al., 2011; Tamrat & Kachnowski, 2012). In addition, system integration was found to be salient to achieving maximum benefits of mHealth for both the mothers and the health systems (Aranda-Jan et al., 2014). Finally, the main themes relating to mechanisms that emerged from the analysis were further categorised, based on perceived characteristics of the technology as an innovation, users as agents of their health, and the health system's social structure. The subsequent sections delineate the mechanisms using theories and empirical evidence.

6.4.1 Characteristics of mHealth as an innovation

On the acceptance of the technological part of the intervention, adoption factors are crucial for the uptake of mHealth intervention such as MSSM (Chib et al., 2014). Characteristics of the technology and affordances of the system were found to be key determinants for adoption and continued use of mHealth services (Akter, D'Ambra, & Ray, 2013; Aranda-Jan et al., 2014). Theories of technology adoption such as TAM (Davis, 1989) and others were reviewed. Theory of diffusion of innovation (Rogers, 1995) was deemed optimal to explain the acceptance and adoption of mHealth because it purports that uptake of an innovation is influenced by characteristics of the innovation, characteristics of the adopters, and environmental factors (Rogers, 2010). In this case an innovation is defined as an idea or practice that is perceived as new, by an individual or a unit of adoption (p.11). Diffusion of innovation theory includes five characteristics of the innovation, as illustrated in Table 6-3.

Table 6-3: Characteristics of innovation in Diffusion of Innovation theory

Characteristics of innovation	Definition
Complexity	Degree to which an innovation is perceived as difficult to understand or use
Relative advantage	Degree to which an innovation is perceived as being better than the idea it supersedes
Compatibility	Degree to which an innovation is perceived as consistent with potential adopters past experience, values and needs
Trialability	Degree to which innovation can be tested or experimented with on a limited basis
Observability	Degree to which the outcomes of the innovations are visible to other people

Source: Rogers (2010)

The two constructs of *relative advantage* and *complexity* are similar to key constructs of TAM of *perceived usefulness* and *perceived ease of use* respectively, albeit no theoretical relationship prevails between the two models (Moore & Benbasat, 1991). Perceived usefulness is the degree to which an individual believes that using a particular system would enhance job performance, while perceived ease of use is the degree to which a user believes that using a particular system would be free of effort (Davis, 1989). Both TAM and diffusion of innovation argue that potential users make decisions to adopt, or not, to use an innovation, based on beliefs that they form about the technology. Focusing on the causes of mHealth outcomes for maternal health consumers, the empirical evidence in literature and the case description indicated that only three constructs of diffusion of innovation theory: complexity, relative advantage, and compatibility, were found to be useful and necessary to generate the observed outcomes for mHealth interventions. Further, these constructs are in line with specific attributes of mHealth such as accessibility, immediacy, personalised solutions, interactivity, and mobility (Akter et al., 2013). These attributes will be described in detail in the following sections.

6.4.1.1 Complexity

Complexity is the degree to which a system is perceived as difficult to understand and use. The mechanism of complexity covers both accessibility and usability of the mobile phone system in terms of perceived ease of access and perceived ease of use. Other studies have

found that ease of use of mobile phones is one of the main drivers of mHealth adoption, and makes it easy for consumers to access health information (Aranda-Jan et al., 2014; Chib et al., 2014; Tamrat & Kachnowski, 2012). However, ease of use of mobile phones alone is not enough; it needs to be coupled with the simplicity of the mobile technology system offering health information services, and users' competences (Akter et al., 2013). Further, in developing countries, mobile phone access and usage are faced with challenges of poor technological infrastructure, limited access to electricity, and even low mobile phone ownership, among other factors (Lund et al., 2012; Noordam et al., 2011; Oyeyemi & Wynn, 2014). Thus, if women would perceive the intervention as easily accessible and its features as easy to use, then the women would likely use the intervention to seek maternal healthcare. The proposition formulated for complexity mechanism is:

Proposition 1

In low-resource environments, if mHealth is perceived as easily accessible and easy to use, then women are likely to use the intervention for maternal healthcare.

6.4.1.2 Relative advantage

The assumption underlying relative advantage is that the women would use the intervention if it is perceived to be more useful than other maternal care avenues in terms of economic benefits and social benefits. The empirical evidence showed that the women found the mHealth intervention convenient as they could access health information from home and in their communities, in addition to having immediate access to health workers. This has been found in other studies as well (Datta et al., 2014; Oyeyemi & Wynn, 2014). Timely access to health information and convenience of services in MSSM intervention motivated the women to use MSSM intervention, because they received timely, reliable, and practical information while at home. This saved them a trip to a health facility – saving on money and time. Thus attributes of immediacy, interactivity, information quality, confidentiality, adequate care, and personalised solutions were found to be part of relative advantage.

In mHealth, immediacy is defined as the provision of timely services, and relevant targeted information (Akter et al., 2013). Interactivity refers to two-way interaction between patients and healthcare providers, which creates value both ways. mHealth is capable of providing tailored solutions to address specific needs of a person based on their profile, such as the women receiving messages corresponding to their gestation age. Further it serves the needs for temporal, spatial, and contextual mobility (Akter et al., 2013). mHealth also reduces time barriers in facilitating urgent care during emergency referrals (Tamrat & Kachnowski, 2012; Vélez et al., 2014). Confidentiality that mHealth interventions afford when discussing sensitive issues that people would rather not discuss face-to-face was found to be an added advantage of MSSM (Aranda-Jan et al., 2014). Hence the proposition:

Proposition 2

If mHealth is perceived as more useful than other maternal care options in an individual's social system, more women are likely to use the intervention.

6.4.1.3 Compatibility

Compatibility in this case refers to the extent to which mHealth intervention is attuned to the local realities of the implementation area. It deals with the question of whether the intervention is accustomed to the socio-cultural values and beliefs, previously introduced ideas on the same issue, and the needs of the women. Chan and Kaufman (2010) assert that technological interventions in developing countries need to align with the local realities to meet the needs of the users effectively. This alignment helps in maximising the full benefits of mHealth on health outcomes. mHealth systems need to fit into the socio-cultural context, because social programmes such as MSSM are theory laden and embedded in the social systems, and their workings are always acted upon by a diversity of stakeholders (Pawson & Tilley, 1997). Therefore, the workings of such programmes are influenced by political, social, cultural, technical, and economic factors (Chan & Kaufman, 2010; Pawson & Tilley, 2004). For instance, maternal care carries a notion of secrecy in developing countries; somehow the use of mobile phones to talk to an unknown person is way beyond the bounds of

culture; promoting privacy and confidentiality may help some mHealth programmes work better (Aranda-Jan et al., 2014). Thus, the proposition follows:

Proposition 3

mHealth interventions are more likely to be adopted if they are consistent with needs of the intended audience and accustomed to the values and beliefs of local communities.

6.4.2 System affordance

System affordance was another mechanism with potential to generate the outcomes of MSSM intervention. What the system or device affords the intended users to do is a necessary condition for adoption and continual usage of technology in health interventions (Chan & Kaufman, 2010; Oosterlaken, 2011). The technology affordances of mHealth presented in Sections 6.4.1.2 engendered communication and collaboration between the women and the healthcare providers that fostered learning (Conole & Dyke, 2004). MSSM offered the women informational resources, affording the women an opportunity to learn health practices at a personal level as they were tailored to the stage of their pregnancy. The women learnt health practices that changed their worldview and impacted on their way of doing things, which increased the adoption of health practices both at home and at the health facility. Hence the following conjectured proposition refers:

Proposition 4

Acquiring knowledge on maternal healthcare from mHealth services influences women's decision to adopt health practices that improve health outcomes in maternal health.

6.4.3 Women as agents of maternal health

Mechanisms relating to agency refer to pre-social powers that people have to engage in behaviour (e.g. position in society) and realise their potential as human beings and social actors (Smith & Seward, 2005). A recent review of literature on mHealth interventions in

low-resourced environments claimed that psycho-social influences and individual preferences as mechanisms offer explanatory value to comprehend technology adoption (Chib et al., 2014). Three agential mechanisms for mHealth use in maternal health were identified: self-efficacy, choice, and enacting the opportunities. Choice and acting on the opportunities will be discussed in Section 6.4.3.2.

6.4.3.1 Self-efficacy

Bandura's (1986) and Bandura and Adams' (1977) social cognitive theory posits that human behaviour is a result of a dynamic interaction among behaviour, cognitive, personal, and environmental factors as determinants of each other. However, a key regulatory mechanism in this dynamic relationship is self-efficacy, people's beliefs and judgments in their capabilities to organise and execute the courses of action required to produce a desired outcome (Bandura & Adams, 1977). Self-efficacy is a moderator between goals and outcomes; it works as a predictor of intrinsic motivation, because it can enhance or impede the motivation to act. In addition, self-efficacy is a form of self-assessment that influences decisions about what behaviours to undertake, the amount of effort put toward task completion, task involvement, and task performance (Bandura, 1986; Schwarzer & Fuchs, 1996). Thus, people with low self-efficacy are less likely to perform related behaviour in the future (Schwarzer & Fuchs, 1996); for instance, in the case of MSSM, to adopt and use the mHealth services, than those with high self-efficacy.

In information systems, self-efficacy has been found to be crucial in determining individual behaviour towards use of specific technologies and performance of related task from the use of information technology (Agarwal, 2000). Thus, with mHealth, an individual who is confident in her ability to use mHealth services would be more likely to adopt and use it. This is because "If people believe that they can take action to solve a problem instrumentally, they become more inclined to do so and feel more committed to the decision" (Schwarzer & Fuchs, 1996, p.1). Further, Schwarzer and Fuchs (1996) assert that adopting health-promoting behaviour is not easy, and that an individual must believe to have the capability to perform the required behaviour. Therefore, in this study the mechanism of self-efficacy is twofold:

- Individuals' confidence in their ability to use the mobile technology system
- Confidence in their ability to actualise the information received to improve health outcomes.

Proposition 5

Women with a high degree of self-efficacy are more likely to adopt and use mhealth services in maternal healthcare to improve their health outcomes.

6.4.3.2 Choice to act on opportunities

Health information empowers consumers or patients to make informed decisions and choices about their health, and have control of their health (Ruger, 2010). Thus, the provision of health information through mHealth affords the women choice or freedom in maternal health. Kleine (2010) asserts that choice is a mechanism regulating outcomes but, more importantly, it is the primary outcome of any development intervention. The realisation of functionings from a capability set involves individual choice to act on an opportunity from the capability set (Hatakka et al., 2014). The women had to weigh the health information received against their experiences involving local values, norms, and beliefs, to decide whether to follow the advice or not. Further, the women exercised rational choice and human agency to act on the information, putting it into practice e.g. deciding and choosing to give birth at a health facility.

Rational choice, where one's choice is in-tune with their preferences, engenders rational action in an individual (Paternoster & Pogarsky, 2009). According to Paternoster and Pogarsky's (2009) theory of rational choice, the choice-making process that could lead to rational action for the women in maternal health would involve:

1. Recognising alternatives to attaining a health goal in maternal care
2. Having information on alternatives, including their costs and benefits
3. Considering and comparing the costs and benefits of the alternatives
4. Making a decision on which alternative to choose, based on that consideration
5. Evaluating the outcome of the choice

Action is a necessary condition to attaining a goal (Cattaneo & Chapman, 2010). Action is driven by a particular goal(s), motivated by the personal value of that goal and self-efficacy, informed by relevant knowledge, and carried out using relevant skills (Cattaneo & Chapman, 2010). The process of moving from the point where the women had gained health knowledge on health practices to the actualisation of the capability to be healthy in maternal health, through adoption of the health practices to improved health-seeking behaviour as an outcome, involved informed decision-making and acting on the advice received. Cattaneo and Chapman (2010) further argue that such actions that lead to change or liberation cannot be imposed on an individual; instead they emanate from the person's perception of the situation at hand. The conjectured proposition is as follows:

Proposition 6

Acting on the health information received from mHealth services facilitates the use of home-based and facility-based health practices and improves health outcomes in maternal health.

6.4.4 The health system

From the operations and implementation activities of MSSM and empirical evidence from literature in general, two factors pertaining to the health system were found to be a constitutive part of the capability to be healthy in maternal healthcare:

- a. Resources in health facilities
- b. System integration

Complementary maternal health resources at health facilities for the provision of quality care and adequate care to the mothers, were necessary for the women to be healthy. System integration was found to be necessary for the success of mHealth projects and coordination of activities between the implementers and health facilities to achieve maximum benefits (Aranda-Jan et al., 2014).

6.4.4.1 Health institution resources

As discussed previously, health facilities in developing countries are faced with resource challenges, from shortage of skilled health workers to lack of proper equipment and medication for provision of quality services (Cole-Ceesay et al., 2010; Oyeyemi & Wynn, 2014). This tends to reduce the effectiveness of mHealth interventions, especially those of health education, reminders, and referrals. Tamrat and Kachnowski (2012), in their analysis of mHealth programmes in MCH around the world, found that the lack of complementary resources such as unreliable emergency transport, coupled with poor quality of services at health facilities, compromise health outcomes. In addition, unavailability of qualified health staff hinders the delivery of health services (Tamrat & Kachnowski, 2012). Some women were deprived of the opportunity to be healthy after implementing the health information received from mHealth services by not receiving adequate care from health facilities. Complementary resources at health facilities are essential for women to achieve different functionings presented in their health capability set. Hence the following conjectured proposition:

Proposition 7

In a resource-constrained environment, poor quality of maternal healthcare services at health facilities is more likely to reduce the effectiveness of mHealth intervention in improving health outcomes.

6.4.4.2 System integration

It is necessary for mHealth interventions to be integrated into the broader health systems at national or even district level to achieve maximum benefits (Aranda-Jan et al., 2014; Mechael et al., 2010; Tamrat & Kachnowski, 2012). Mechael et al. (2010) urged that such integration, coupled with interoperability, ensures flow of information at every level of healthcare; it improves data collection and management, reducing redundancies and time wasted in looking for information. System integration enhances point of care support in linking remote health workers with the most appropriate sources of information, when and

where it is needed to help pregnant women effectively (Michael et al., 2010; Ngabo et al., 2012).

Governments play a key role in the success of mHealth projects. Government participation ensures policy frameworks that describe procedures on how health workers would be involved in effecting treatment based on support from remote consultations, prescribing therapy despite their physical isolation, and how intermediaries would be involved during patient referrals (Tamrat & Kachnowski, 2012). Aranda-Jan et al (2014, p.11) asserted that:

The participation of the government . . . is a fundamental aspect for success of mHealth projects. Failure may happen when there is a lack of integration into the healthcare system and, particularly, then there are unclear roles and responsibilities at the various different hierarchical levels . . . involved in implementation and operation.

This may result in the consumers not getting adequate care from health facilities, diminishing the effectiveness of mHealth interventions. Thus, the following MRT is proposed:

Proposition 8

Integration of mHealth intervention into the existing healthcare system is more likely to improve access to health information and services, health outcomes, and efficiencies in maternal health.

6.4.5 Summary on mechanisms

From the identified mechanisms, a total of eight propositions were supposed to explain the potential of mHealth in improving health outcomes in maternal health, as summarised in Table 6-4:

Table 6-4: Summary of the mechanisms with their corresponding propositions

Mechanisms	Propositions
Complexity	In low-resource environments, if mHealth is perceived as easily accessible and easy to use then women are likely to use the intervention for maternal healthcare.
Relative advantage	If mHealth is perceived as more useful than other maternal care options in an individual's social system, more women are likely to use the intervention.
Compatibility	mHealth interventions are more likely to be adopted if they are consistent with needs of the intended audience and accustomed to the values and beliefs of local communities.
System affordance	Acquiring knowledge on maternal healthcare from mHealth services influences women's decision to adopt health practices that improve health outcomes in maternal health.
Self-efficacy	Women with a high degree of self-efficacy are more likely to adopt and use mhealth services in maternal healthcare to improve their health outcomes.
Choice to act on opportunities	Acting on the health information received from mHealth services facilitates the use of home-based and facility-based health practices and improve health outcomes in maternal health.
Health institution resources	In resource-constrained environment, poor quality of maternal healthcare services at health facilities is more likely to reduce the effectiveness of mHealth intervention in improving health outcomes.
System integration	Integration of mHealth intervention into the existing healthcare system is more likely to improve access to health information and services, health outcomes, and efficiencies in maternal health.

6.5 Proposed conceptual framework for the study

The analysis presented above identifies a causal pathway that links mHealth and maternal health outcomes. In this context, mHealth is an enabling technology deployed to improve the health and wellbeing of women in pregnancy and childbirth. Based on this analysis of mHealth in maternal health in developing countries, the author proposes an analytical framework, depicted in Figure 6-2, that describes the ways in which mHealth generates opportunities for maternal health outcomes in developing countries, the utilisation of these opportunities by the women as health agents, and the realisation of maternal health outcomes. Such an understanding of mHealth workings through causal mechanisms can foster adoption and effectiveness of mHealth services.

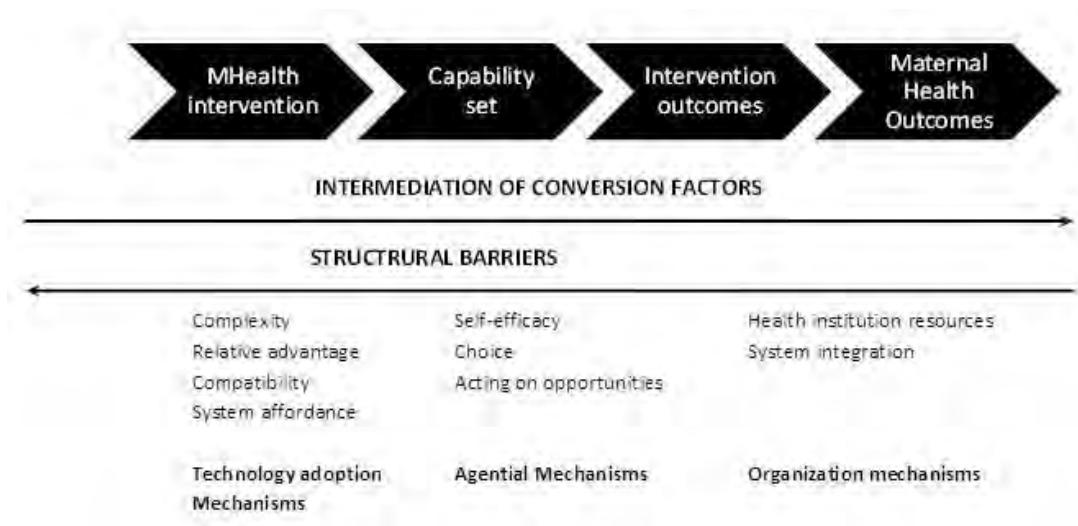


Figure 6-2: A pathway from mHealth access to maternal health outcomes

The analysis has shown that the process of realising maternal health outcomes through the use of mHealth starts with the adoption of mHealth services by the consumers. Just like any other technology, the adoption and use of mHealth in maternal health is regulated by the beliefs that the users form about the technology, through the mechanisms of complexity, relative advantage, and compatibility (e.g. Corneille et al., 2014). It is also argued that what the technology affords the users can motivate or discourage the adoption and continual usage of mHealth services. These characteristics of technology, when broken down into specific attributes of mHealth, are what generate the opportunities or capabilities for women in maternal health (Aker et al., 2013; Corneille et al., 2014; Huq et al., 2014).

The use of mHealth services and the utilisation of the opportunities are determined by self-efficacy and choice. As discussed previously, self-efficacy is vital to achieving any goal. In this context, it refers to the women’s confidence in themselves to use the mHealth technology, and to achieve maternal health outcomes. The underlying assumption in CA is that an introduction of mHealth intervention increases the freedoms or options a woman can have in maternal health. Of importance is the awareness of such freedoms or options among women. Kleine (2010; 2013) asserts that the starting point should be: *Does choice (freedoms or opportunities) exist? If it does, are the women aware of the choice? If yes, are they using the choice?* Using choice means selecting activities from a capability set; this in the context of mHealth pertains to acting on the information i.e. choosing to deliver at a health facility under skilled midwife supervision.

Once the intervention outcomes have been achieved, once a woman chooses to deliver at a health facility, for this to translate into favourable maternal health outcomes, the health system plays a big role. Complementary maternal health resources at health facilities facilitate the provision of adequate and quality care. System integration of the mHealth intervention into the health system encourages the involvement of government and health workers at all levels, which enhances interoperability and work efficiencies that may improve the effectiveness of mHealth. Outputs from such an integrated health system have a positive impact on maternal health outcomes that can feed into development outcomes of reduced maternal morbidity and mortality (Oyeyemi & Wynn, 2014). The whole process from technology adoption to maternal health outcomes is intermediated by conversion factors that are either enabling, leading to realisation of desire outcomes, or regressive, yielding adverse outcomes for women.

6.6 Summary of the chapter

The study engaged CA for the explanation of mHealth use in maternal healthcare, from technology access to the realisation of health outcomes. For the best explanation of the effects of mHealth as an innovation in maternal health, other theories were integrated into CA to understand how the effects come about. These theories augmented the explanatory power of CA, especially in relation to ICT and the health domain. mHealth interventions facilitate a capability to be healthy for expectant mothers through access to health information and services, using mobile phones. A number of mechanisms were found to be instrumental in linking the health capabilities to their associated outcomes. The causal pathways linking mHealth to maternal health outcomes involve necessary conditions pertaining to technology adoption, human agency, and the health system. The chapter has highlighted the inner workings of mHealth capable of producing diverse effects for individuals, depending on context. It further proposed a conceptual framework for the underlying causes, with potential to explain mHealth outcomes for maternal health consumers in developing countries.

The next chapter analyses mHealth in the context of MSSM using the identified mechanisms.

7 CASE ANALYSIS

7.1 Introduction

The previous chapter conjectured a number of mechanisms with potential to produce mHealth outcomes for maternal health consumers. This chapter presents the findings derived from the interviews carried out in the main phase of the research study to corroborate the hypothesised mechanisms and their corresponding propositions. From this analysis, the theories of how mHealth can improve maternal healthcare in developing countries, rural areas of Malawi to be specific, are reviewed, amended, and developed as appropriate. Middle-range theories (MRTs), relating to each mechanism identified, are presented. The chapter intends to unpack the answers to the main research question: ***How are maternal health outcomes achieved through the use of mobile phones by women in developing countries?*** The realisation of the outcomes depended on the interactions among MSSM, agency, and a myriad of structures, of which their causal powers gave rise to the outcomes.

The chapter starts with the profile of the women interviewed as a representative sample for the MSSM user community in Section 7.2. Sections 7.3 to 7.6 present the attributes of MSSM technology and how they generate opportunities to improve health outcomes in maternal health for the women. The agential mechanisms of self-efficacy, choice, and acting on the opportunities generated are substantiated through an explication of the processes in activities that women engaged in to achieve health outcomes and how these were enabled or constrained by contextual factors in Sections 7.7 and 7.8. Finally, the social mechanisms relating to the health system are delineated in Sections 7.9 and 7.10. Each conjectured proposition pertaining to the identified mechanism is reviewed in the context of MSSM and revised accordingly. Sections 7.11 and 7.12 further describe the unintended consequences of MSSM, and other basic human capabilities generated for the women. Section 7.13 gives a summary of the chapter.

7.2 Demographic characteristics of the MSSM users

7.2.1 Demographic profile of the respondents

Twelve women using the MSSM intervention were interviewed, as shown in Table 7-1. The women had diverse backgrounds and characteristics.

Table 7-1: Background characteristics of selected mothers using MSSM intervention

Characteristics	Mothers n=12
Age (In years)	
<20	1
20-25	2
26-30	5
>30	4
Marital Status	
Married	6
Married (polygamous)	2
Single	4
Number of children	
<2	3
2-4	5
>4	4
Religion	
Islam	5
Christianity	7
Education levels	
Never been to school	1
Junior primary - Standard 1-5	3
Senior primary - Standard 6-8	4
Junior secondary - Form 1-2	2
Senior secondary – Form 3-4	2
Own a mobile phone	
Yes (personal)	3
Yes (family)	3
No	6
Time using the intervention (in months)	
<6	2
6-12	6
>12	4
Monthly family income (in US\$)	
<\$50	7
\$50-\$100	4
>\$100	1

The average age of the women was 28 years; the youngest was 19 years; the oldest was 39. The majority of the women were married, two in polygamous marriages. All the women affiliated themselves to either Islam or Christianity. The women had low education levels. One among them had never been to school; however, she could read and write. Only two completed secondary education.

None of the women was employed; they mainly depended on subsistence farming for livelihood with some running small businesses and engaging in casual jobs. The average household income (including husband income for those who were married) for the women was less than US\$30 a month. Due to the low income, mobile phone ownership among the women was low; half of the women did not have mobile phones. Half of the women, who used their own mobile phones for the intervention, used their husband's phone and they did not have access all the time.

At the time of data collection the intervention had been operating for 16 months. Only one of the women interviewed had used the intervention for the entire 16 months. The period of intervention usage ranged from two to 16 months. Ten out of the 12 women had been using the intervention for more than six months. The researcher considered these as credible respondents, and envisaged the time period of more than six months as an adequate system interaction period for the women to comprehend their perception and experiences of the intervention; because it is a considerable amount of time to observe change, more especially in pregnancy.

7.2.2 General characteristics of MSSM users

In line with the demographics of the respondents for this study, the monitoring and evaluation reports for the project showed that the average age of MSSM users was 26 years at the time of data collection (recall Section 5.3.3). The statistics on education attained by women in the pilot district show that 64% attended some primary education with 6.6 % completing, and 6.2% attended some secondary education with only 2.9% completing (Malawi NSO & ORC Macro, 2011); this compares with the education levels of the women interviewed. In Malawi, over 60% of the population live under the international poverty line

of US\$1.25 per day (UNICEF, 2013); most people in rural areas have an income of less than US\$30 a month. In addition, most women in rural areas are not employed; they depend on subsistence farming (Malawi NSO & ORC Macro, 2011). Therefore, it can be inferred that the demographics of the interviewed women were representative of the characteristics of the women using MSSM in the piloted area.

7.2.3 MSSM knowledge

The women interviewed learnt about the MSSM intervention from various sources. Most of them became aware of the intervention through the Community Volunteers, HSAs and public meetings held by Chiefs. Some women heard about the interventions from their friends, while others learnt about it from the health talks⁵ at the ANC clinic. The outreach team from the implementing agency and health workers would use a 'health talk' period to promote the intervention to the women. In all the four health facilities, women who went to seek care for trivial ailments that could be resolved at home were encouraged to join MSSM.

The general understanding of the intervention among the women using it and the community at large was that it was an organisation that had come to promote safe motherhood by helping pregnant women and mothers or caregivers of children.

MSSM is helping us women with pregnancy and motherhood issues, they give you advice on what to do with what you are experiencing or going through

(Mother-10)

The community had a clear understanding that the project aimed to provide women with health information about maternal health, helping them with minor ailments that could be resolved at home and encouraging them to go to the clinic in good time with conditions that required medical treatment; and ultimately reduce deaths during pregnancy and childbirth. All the respondents described the intervention as a clinic by phone where one could call in

⁵ A session at ANC where a nurse gives advice to pregnant women about health practices in pregnancy, the do and don'ts.

anytime and talk to health personnel. It was viewed as a health centre operating on the phone where women got help from doctors that they could not see. In remote areas of Malawi, people refer to anyone working for the hospital or clinic as a doctor. Consequently, all the respondents from the community (the women, their partners, Community Volunteers and even HSAs) referred to the HLWs as doctors. Some women believed that they talked to doctors at the district hospital.

... MSSM is a clinic by phone . . . even though you do not see the doctors face-to-face . . . but they are able to help you with any problem that you have or any unusual signs or symptoms that you can observe (Mother-4)

From this point onwards health workers and HLWs are referred to as doctors in the extract quotations from the interviews with respondents; where necessary, clarification will be provided.

7.3 MSSM access and usage

With a focus on Proposition 1 and the complexity mechanism, this section discusses the factors that facilitated MSSM access and usage. These included availability of phones, technology infrastructure, and cost of services, perceptions, and attitudes towards the intervention.

7.3.1 Availability of phones

The expectant women were required to have or access a mobile phone to use the MSSM services. Contrary to the hype in literature and the popular press that mobile phones are prevalent even in remote areas of developing countries, in Malawi mobile teledensity is still low at 27% (UNICEF, 2013). The four catchments areas of the intervention had low mobile phone ownership; only 30% of the household had mobile phones. Further, these were mostly owned by the men of the house. This could partly be due to high telecommunication costs in Malawi (Mtingwi & Van Belle, 2013), and the disparities that exist between men and women in developing countries (ITU, 2010).

Despite each village having a community phone, some women faced challenges in accessing a mobile phone for MSSM usage. Some women had to walk long distances to the Community Volunteer's home. In bigger villages women could walk more than a kilometre to the volunteers' houses; some women found this difficult especially in later phases of their pregnancies. The Community Volunteers⁶ confirmed that only a few of the women using community phones would go to a Community Volunteer's house to access the MSSM services. In most cases volunteers were rarely available for the women. There were cases where women could visit a Community Volunteer's house several times and not find him/her. This discouraged the women from using MSSM services. Some women used their own initiative and sought other means of accessing MSSM:

There are times when you go to his house and you find he is not there; maybe he has gone to the fields. There were times I could go to the volunteer's house every day of the week and not find him home . . . so I had to ask him to teach me how to retrieve the messages on my own using a borrowed phone. (Mother-1)

However, some Community Volunteers were committed and were usually available for the women. Some of them were so organised that they used appointment schedules for each client.

... almost every time you go to her [Community Volunteer's] house you find her. She actually plans it very well to wait for the women going to her house or her visiting them. She knows who comes on which day. (Mother-12)

Furthermore, some other volunteers followed up on women who came to use the mobile phone and did not find them.

Women using shared phones did not have access to a mobile phone all the time, sometimes even in critical situations. The reasons for this ranged from owners of the phone not usually being available during the day, some owners being away for an extended period, to others charging a small fee for people to use their phone. This was because some owners needed

⁶Conference version of this section was published as: Nyemba-Mudenda & Chigona (2013).

money to charge the phone battery; due to lack of electricity in rural areas people pay to have their phone charged using a car battery or other means.

The technical condition of the community phones also made it challenging for the women to access the MSSM services. After one year of intervention, most mobile phones (over 50%) given to the Community Volunteers were not working properly, with problems ranging from keypads not responding to batteries not charging.

... more often when I go to the volunteer's house to call MSSM . . . I find that the phone is not charged, or he would say it is being charged somewhere else, or just that the phone is not working properly. (Mother-3)

Attempts to repair damaged phones proved futile. The project could not replace the damaged phones with new ones, due to lack of funds. Maintenance and replacement of community phones were not planned for and there were no procedures to follow to have them fixed. However, some Community Volunteers borrowed mobile phones from the village to continue helping their clients.

7.3.2 Technology infrastructure

The technological factors that affected access and use of MSSM included system outage, poor network coverage, and lack of electricity supply. Sometimes, the women could not get through to MSSM due to the system being out of order and services not being available, or the line being busy.

Sometime you go and call the line but it would be busy . . . sometimes I would try for a long period but still finding it busy then I would just give up and come home . . . I would say it happened for two consecutive weeks. (Mother-9)

Some women could not connect to MSSM due to poor network coverage and network congestion. Monitoring and evaluation data showed that 10% of calls in a given month were uncompleted due to network failure. This disrupted the MSSM activities as network outage could keep MSSM out of reach for days, and affected the communities' perception of the intervention.

Access to electricity in rural Malawi is a challenge; only 9% of the total national population has access to electricity (Malawi NSO & ORC Macro, 2011). The Community Volunteers were given a solar charger for the community phones, to be shared among five to seven villages. Coordinating access to the solar charger was a challenge, so most phones would be out of power or switched off to preserve power. This was the case with personal phones as well. Consequently, messages were not reaching the women on time and some voice messages were not being retrieved, affecting women's access and use of the intervention.

7.3.3 Cost of services

Rural areas of Malawi are generally subjected to high levels of poverty, with the majority living below the poverty line (Malawi NSO, 2012b). Offering the service for free to the women had a positive effect on the uptake of MSSM services. All participants concurred that women were able to use the intervention because it was free; they did not have to spend any money on airtime to access the service. It was possible for the women to use MSSM services because the intervention as designed made accessibility and usage of mobile phone readily available at no cost at all on the part of the consumer.

On the other hand, the MSSM operations proved to be expensive to sustain on the part of the development agency and the implementing agency, because of high telecommunication costs in Malawi. Initially, they planned MSSM services to be available for 24 hours a day; this turned out to be very expensive and they reduced the services to only operate between 7AM to 7PM. The implementing agency also cut down on the frequency of delivery for some text and voice messages so as to work within the budget given by the donors. Communities wished the services were offered 24 hours, but this was not possible. The community felt that out of work hours could be useful, as some conditions occurred during the night and it would be too late to wait and call MSSM in the morning.

7.3.4 Mobile phone skills

At the beginning of the intervention most women did not know how to use mobile phones. The project afforded them an opportunity to gain mobile phone literacy and start using mobile phones on their own. Mobile phone skills were not a requirement to using MSSM

since the women could access the system through the Community Volunteers; however, the project prompted the women to acquire and develop their mobile phone skills. The women with no prior or under-developed mobile skills were often trained by their family and friends if they were using shared mobile phones. Those using community phones were trained by the Community Volunteers.

The women who are interested in retrieving their own messages using my phone I teach them how to do it and when they come to listen to the messages, I just give them the phone and they do everything by themselves (CV-1)

The women learnt how to open a text message and how to call the helpline using the short digit code, and choosing the correct options to either talk to the HLW or retrieve a voice message. At the time of data collection, almost all of the women interviewed could make and receive a voice call and read messages. Additionally, the women used mobile phones for communication in other areas of their lives, such as talking to their long-distance families and friends, business, employment e.g. looking for casual jobs or receiving messages on casual jobs available.

7.3.5 Usage of system features

Most women, especially those using their own phones, found MSSM easy to use. The system operated in two common vernacular languages of the area. The IVR instructions on the system were designed in a clear and simple manner for the women to understand and follow without problems. The short digit code for the hotline was easy to memorise; almost all the women interviewed could narrate it off by heart. Some of the respondents demonstrated how they retrieved their messages. However, some women failed to retrieve their voice messages due to entering the password (their EDD) in a wrong format. These women required to be retrained. In addition, other women could call the short digit number but failed to access the services altogether because they could not understand and follow the instructions:

One day the Community Volunteer was not home, but he left the phone for me to use . . . the voice on the phone was telling me to choose a language . . . they were

telling me numbers to choose from but I did not know what to do (Mother-8)

Understanding of system operations depended on literacy levels, while system usage depended on literacy levels and self-efficacy; some women just feared talking on the phone to a 'stranger'.

Sometimes you just feel like not calling MSSM . . . you think that I should walk all the way to the Community Volunteer and talk to someone I do not know . . . what am I going to say? (Mother-4)

Women with low literacy, who could not manage to access messages on their own, were assisted by Community Volunteers. The Community Volunteers operated the phone, navigated the IVR instructions, and gave the women the phone when the HLW picked up or the message started playing. Among the three system features, using the hotline (voice call) was perceived to be easiest and consequently the most preferred mode of communication within MSSM by the women. To use the hotline, women would simply call and choose an option to talk to the HLW; other options required higher literacy skills e.g. reading for text messages.

7.3.6 Attitudes toward MSSM

The attitudes about the system were shaped by the differences on the way pregnancy is understood amongst the local communities. Most people did not understand information on pregnancy development, and how it was possible that someone who did not know them could tell what was going on in their bodies, even to the extent of expected date of delivery. Consequently, some people attributed this to magic and evil spirits. In all the communities there was a belief that the intervention was a satanic gimmick to get blood from pregnant mothers' bodies and kill the babies through magic.

Even my husband at first was very sceptical about it [MSSM] . . . he used to say that a lot of women have gone missing because of MSSM, and that I will eventually disappear leaving him alone to take care of the children . . . When I just started using MSSM, he would shout at me and we could argue over MSSM . . . after I followed

their advice and saw that it had helped me, he was still saying 'Look I told you this is Satanic, it is working magic'. (Mother-9)

MSSM used the EDD of the women as their unique identifier and a password to retrieve messages; this made people uncomfortable. Malawi has no system for self-identification e.g. national identity card or social security number, so people are not used to being identified by a number. Due to limited understanding of MSSM workings and the belief that the intervention was satanic, people associated the unique identifier/password in MSSM with the Bible prophecy of the Mark of the Beast 666⁷. Because of this belief, most men forbade their wives from using MSSM; some women who had already joined the intervention stopped using the services. Similar findings were reported in a biometric project in the finance sector in Rwanda where bank staff initially refused to use the technology, thinking it was under satanic influence (Berger & Nakata, 2013). In Zambia, similar beliefs brought resistance in Subscriber Identity Module (SIM) registration (Donovan & Martin, 2014).

Eventually women developed trust in MSSM because the advice was working and not causing any harm, but they did not fully comprehend how the messages received could tell them what was going on in their bodies:

But sometimes I wonder that how come these people that I have never met know the date that I will give birth . . . sometimes I think that may be they are able to see the baby inside of me. (Mother-12)

In remote areas of Malawi, pregnancy is a private matter; other people only get to know about it when it starts showing. Some women even hide the pregnancy by adopting baggy clothing so that no one knows about it until childbirth.

⁷ Revelation 13: 15-18

15 The second beast was given power to give breath to the image of the first beast, so that the image could speak and cause all who refused to worship the image to be killed. 16 It also forced all people, great and small, rich and poor, free and slave, to receive a mark on their right hands or on their foreheads, 17 so that they could not buy or sell unless they had the mark, which is the name of the beast or the number of its name. 18 This calls for wisdom. Let the person who has insight calculate the number of the beast, for it is the number of a man. That number is 666.

Other women feared witchcraft; they believed that if they joined MSSM, then other people would know about the pregnancy and could cast a spell on them to miscarry the pregnancy or have a pre-term baby. As such, talking to a stranger on the phone about pregnancy, as was the case with MSSM, was a great leap out of bounds of their cultural norm. Due to such beliefs, some women could not join or continue using the intervention because their families i.e. partners, uncles or elderly women, refused to give them permission to use the intervention:

I have come across some women who have interest in using MSSM but their husbands do not allow them to use the intervention. These women are told that 'if you go there and start using MSSM, do not come back to my house'. So even if such women would want to use the programme they do not, out of fear and respect of husbands. (CV-1)

Women could not go to the Community Volunteer on their own without getting permission from their husbands; if the husband refused, then, culturally, women could not go against the husband's decision. Thus, most women failed to use MSSM services properly, even if they desired to do so.

7.3.7 Summary of Middle Range Theory 1

Low complexity and perceived ease of use emerged as mechanisms in the pathway of mHealth uptake and adoption. mHealth intervention with simplicity-in-design can enhance accessibility and usability of mHealth services for women in rural areas. The simplicity of MSSM made it easier for the women to use the system features. The skills required to access MSSM were minimal, and most women learnt easily how to operate a phone, make a call, and retrieve messages. Further, since the intervention was mobile phone-based, a tool that some women were already familiar with, this also enhanced their perception of ease of use. Perceived ease of use was strongly enabled by the provision of community mobile phones, and free services. Still, some women had challenges accessing MSSM services, which were attributable to low literacy levels, low self-efficacy, technology and infrastructure drawbacks, family support, and cultural beliefs. Therefore, Proposition 1 holds in the context of MSSM and the MRT can be summarised as follows:

Provision of a means to access mHealth services at no cost for the consumers and simplicity of the technology system in limited resource areas enhance perceived ease of use of the services, which tends to increase its adoption.

7.4 The relative advantage of MSSM

For the explanation of relative advantage, refer to Section 6.4.1.2. The relative advantage of MSSM over other maternal care facilities such as the clinic, TBAs and traditional healers, were as follows:

- a) Immediate access to health information and workers
- b) Interaction with health workers
- c) Saving money and time
- d) Quality maternal health information
- e) Quality services
- f) Confidentiality

7.4.1 Immediacy of health services

The ubiquitous power of mobile phones afforded the women instant access to health information and services anytime in the convenience of their communities. The women received timely advice relevant to the complication experienced or gestational age, which turned out to be accurate in serving the purpose most of the time.

You get to know about things going on in your body in a good time and instantly . . . when you call MSSM they explain to you clearly that the problem you are having is this one and it can be healed by doing that . . . and you get to know what to do about your situation. (Mother-8)

Most maternal health ailments in the communities were basic and caused by ill practices in maternal care e.g. not eating enough, doing too many heavy jobs, and not resting enough. Previously, some women would walk long distances to a health facility with trivial ailments

just to be given advice; for those who ignored going to the clinic, the minor problems would escalate to major complications. MSSM services increased access to health workers and, with the advice received, the women could see immediate change in their conditions. Consequently, many cases were being resolved in the community without going to the clinic: *“Three quarters of the calls were resolved at home”*. One participant gave an analogy – that having access to MSSM services was like having a neighbour who works at the clinic, where you can get useful medical advice anytime. The participants felt that MSSM services were immediate and convenient as they got help from home.

7.4.2 Saving time and financial resources

Most of the women failed to seek medical attention due to long distances to health facilities. Some women had to walk more than 15 kilometres to get to a health facility, and would spend most of the day at a health facility, due to long queues. Because of their low income status, most women struggled to raise money for transport to health facilities.

... the clinic is very far from here . . . so I thought since I did not have money I might as well join MSSM where I can talk to doctors and get medical help for free . . . I joined MSSM so that even if I am not able to go to the clinic, I still should be able to talk to doctors when I am not well or I feel anything unusual. (Mother-12)

Positive effects of increased knowledge in maternal health were greater for women who lived a long distance further from health facilities; they leveraged the convenience of mHealth services. Furthermore, by getting help while at home, the women had the opportunity to save time and money. The women could use these resources for other things that benefitted them and their family or they had reason to value, as depicted in Table 7-2. The women were saving money that could have been used on transport costs to get to a health facility or on buying medication that was not necessarily required.

Table 7-2: Activities engaged in with savings from MSSM

<i>Benefits</i>	<i>Activities</i>
Saving money	<ul style="list-style-type: none"> - Meeting other basic needs of life e.g. buying food - Preparing for childbirth and baby
Saving time	<ul style="list-style-type: none"> - Doing house chores as usual - Working in the fields - Undertaking business - Involved in community development work

For some women, MSSM was an alternative means of healthcare that saved them money that could have been used to seek care elsewhere e.g. traditional healers who charged a fee for their services. The preventative messages also assisted in avoiding complications that could end up costing them money and time when admitted at a health facility. The money saved was used to meet other needs such as “*food and soap*”. Other women used the money saved to prepare for childbirth and baby i.e. starting collecting the things needed for childbirth at the clinic.

7.4.3 Meaningful interaction with health workers

The women found the communication offered by the hotline useful as it allowed them interaction with the health workers. The information empowered the women to communicate with local health workers in a way that was beneficial for both parties.

7.4.3.1 System features interactivity

In addition to perceived ease of use, the women preferred the hotline because a telephone conversation is synchronous. The women could get immediate medical help and seek clarifications on other maternal health issues. The women got more information from talking to HLWs than from a text or voice message.

... you might call the doctor on one issue but they end up advising you on a number of things and reminding you the things that you have heard before so that you do not forget. (Mother-11)

The women valued the supplementary messages they received through voice and text messages. However, the women voiced concerns of failing to get feedback or clarification on some things they did not understand. A theory of information richness claims that

communication media vary in the way they process information, depending on their capacity for fast feedback, number of channels used, number of cues utilised, and personalization, among other factors (Daft & Lengel, 1984; Daft & Lengel, 1986; Lee, 1994). On a rich-lean continuum, face-to-face interactions are the best, followed by telephone conversations, and then personalised written documents e.g. emails or memos, and finally impersonalised written documents (Daft & Lengel, 1986). Among the three mediums, the hotline was richest in information, since it supported interactivity, immediate feedback, and could convey multiple cues from the conversations. Voice and text messages lacked interactivity, the ability to convey multiple cues, and immediate feedback.

In all the piloted areas, the women used voice messages more than text messages. They preferred listening to voice messages because *“It is like someone telling you what to do, which is easier to remember”*. Since voice messages are more ephemeral compared to text messages, one would expect that keeping an SMS on the phone would be a better reminder than recalling a voice message. However, due to low literacy levels and poor digital literacy in particular, the women refrained from using text messages, as some could not read and understand the messages properly. In addition, similar to the findings in MoTeCH, Ghana, comprehension of text messages among the women was superficial (Osborn, 2013). Malawi like many African countries has an oral culture; most people in rural areas are more familiar with using speech for communication than reading and writing (Brady, Dyson, & Asela, 2008), thus the women found voice messages easier to remember.

The women liked the voice messages because they were able to replay a part that they did not understand clearly.

I like the voice messages . . . sometimes if I don't understand something properly I can repeat that part several times until I get what the message is saying

(Mother-1)

In addition, voice message content carried much more information than text messages, due to limitation of characters in the SMS feature, as illustrated in Table 7-3.

Table 7-3: Sample SMS and Voice Messages

Message Type	SMS	Voice message
<u>Week 6</u>	SMS1: At your first ANC visit, you will get tests and medicines to ensure that the baby is healthy. Your husband can also learn what to do to keep the baby healthy.	A pregnant woman should be careful to avoid overworking or getting over-heated. Get help with heavy lifting and try to work during cooler hours or in the shade. Your body will experience a lot of changes during your pregnancy. It is important to know which of these changes are normal and which ones are warning signs that you need to go to the health centre about. Heavy bleeding, fever, sudden swelling, convulsions and severe headache are important warning signs. If you experience any of these problems, go to the health center as soon as you can. You and your baby may be at risk. At your ANC visit, they will also remind you of these warning signs and tell you what to expect during your pregnancy. It is important to visit the ANC early in your pregnancy.
	SMS2: Go to the clinic right away if you have: heavy/painful bleeding, dizziness, fast heartbeat, bad headache, fever, vomiting, bloody/dark urine or urination pain.	
<u>Week 40</u>	SMS1: Don't worry if baby hasn't arrived yet, but go to the ANC to be sure all is fine. If you have delivered, congratulations! Remember to visit clinic after delivery	Has your baby come? If not, it will be here soon. Be ready to go to the health facility as soon as labour starts. Delivering there is safer for you and your baby. If you have delivered, congratulations! Remember to visit the clinic after delivery. In the first six hours of birth your baby will be weighed, measured and looked over head to toe to make sure that he or she is healthy. If your baby weighs less than 2.5 kilograms at birth, it is will be important to keep them warm by keeping them close to you near your breasts. Feeding the baby water or other food vitamins minerals or medicines is really dangerous for the baby . . . it can cause diarrhoea, vomiting and other sicknesses.
	SMS2: If your baby weighs less than 2.5 kgs at birth it is will be important to keep them warm by keeping them close to you near your breasts.	

Thus, the women found the weekly voice messages detailed on each specific topic, and easy to follow, compared to text messages. The same was the case with health talks, which were found to be brief with little information.

7.4.3.2 Interaction with local health workers

With the knowledge that women gained from the initial assessment on MSSM, they were able to engage with health workers as informed patients in consultations, at least better than before. They were able to explain their problems clearly and would ask questions and seek clarifications on things they did not understand. It improved their sense of control over their health and would, in a way, request a service for the needed medical treatment. For instance, if they were first seen by an HSA at the clinic and the HSA did not understand their questions, they were referred to a nurse or medical assistant:

Most women who receive messages from MSSM when they come, they ask a lot of questions . . . it is like they seek clarifications on some things . . . When I realise that I

do not know or understand what they are talking about I refer them to the clinic to talk to the nursing staff. (HSA-1)

Previously, however, due to lack of knowledge, they would settle for whatever help was given to them and would be rushed through a consultation. Going to the clinic as informed patients changed things for the women; consequently, health workers could assist the women effectively and on time.

7.4.4 Source of quality maternal health information

The analysis of the quality of information for the consumers was based on the utilitarian benefits of MSSM:

1. The degree to which the mHealth information services served its purpose
2. The degree to which the services met the needs of the pregnant mothers

The spectrum of the health information accessed from MSSM covered the necessary topics for the women to keep healthy during pregnancy and deliver health babies e.g. dealing with discomforts, normal and danger signs in pregnancy, and the importance of accessing healthcare, among others. Table 7-3 illustrates some example messages and extracts from the women's narratives, confirming the kind of knowledge that they gained from MSSM and how they used it to meet their needs.

Table 7-4: Sample of health messages received from MSSM matched with women's descriptions

Type	Example of Message	Narratives of women
Milestones in baby development	Your baby's fingernails and fuzzy hair are appearing and it's able to do things like swallowing and kicking. In the next three weeks, your baby will double in size.	"... they explain to you any problem that you have in your body if you are not feeling well; you even get to know the size of your baby and how it is developing at each stage of pregnancy...."
Dealing with discomforts	The baby is very big now and may be causing you backaches. Try to keep active, but avoid lifting heavy things like water, firewood, and other children.	"When I was pregnant my legs were getting swollen, and they advised me to be sitting on the floor with my legs flat and also to eat vegetables, which have not been cooked for a long time...."
Danger signs in pregnancy	Go to the clinic right away if you have: heavy/painful bleeding, dizziness, fast heartbeat, bad headache, fever, and vomiting, bloody/dark urine or urination pain.	"There was also another message on the danger signs in pregnancy, things that I should not ignore like loss of blood, fever, fainting and swelling of feet."
Accessing healthcare	You and your baby need folic acid. At ANC, you will get folic acid tablets that will help your baby's brain and spine to grow well and will help keep your iron up.	"...one message told me to go and start ANC at the nearest clinic . . . and I started, another message was on the kinds of food that I could eat that were nutritious and good for pregnancy."
Nutrition	You and your growing baby need food for energy, body building, and protection. Meat, eggs, greens, vegetables, rice, and fruits help your baby grow.	"They also told me to be eating five groups of food like pumpkin leaves, papaya, fish, meat, etc . . . They also said I should be taking a lot of water...."
Household health practices	Malaria is very dangerous. It can cause low blood in the mother and miscarriage - where you lose the baby. Help yourself by sleeping under insecticide treated nets.	"They tell us to be sleeping under a mosquito net every night all year through because it's easier for a pregnant woman to catch malaria . . . if you are sick . . . that affects the health of the baby as well . . . with these messages even if it's very hot you feel obliged to sleep under the mosquito net"
Planning for delivery	Now is a good time to think about baby's arrival and your delivery. Have you thought about transport to hospital or clinic in an emergency?	"... they also helped me to prepare for childbirth before it was time, they sent me a message of the things I will need to take with me to the clinic, luckily that time I had money and I bought everything the following day."

The baseline study for the intervention showed that the communities had average knowledge on health issues including maternal healthcare, even though most of them were not seeking medical care from health facilities. The access to MSSM intervention exposed the women to detailed health information at a personal level, the same information they might have known previously. It was evident that the women using MSSM were learning new things related to maternal health and general health practices. Since the messages were personalised and time-specific, relating to what a woman was going through at that particular time, it was easier for them to understand and process such information, and even verify if it worked for them. As discussed earlier, the women enrolled in the

intervention due to ill-health and, for some, out of curiosity. After seeing positive results from MSSM use, the women continued to use the intervention.

Some women viewed the intervention as a way of getting up-to-date information on pregnancy. They perceived that times had changed and could not continue using what worked for their grandmothers or mothers, as shown in the extract below:

I get good advice from MSSM that my friends or elderly women cannot tell me . . . Life nowadays requires people to be civilised [exposed to knowledge], not to live in ignorance like before . . . so MSSM helps us . . . it helps you to plan for the future. (Mother-3)

For some other women, MSSM was an alternative source of information. A good example were teenage mothers who got pregnant while in school, and did not have support from their families, because they were despised and neglected since they had been against the socio-cultural norm by having children outside wedlock. They lacked guidance on pregnancy-related issues from elderly women. These young women embraced the intervention as a source of information to understand what was going on in their bodies.

7.4.5 Quality of service

The quality of MSSM services in terms of HLW's hospitality, care, and the perceived confidentiality inspired the women's trust in the system, and they were encouraged to use it. The HLWs promptness and enthusiasm in service delivery encouraged the women to speak freely, without reservation. Consequently, the women were satisfied with MSSM patient service delivery compared to other sources. In using MSSM services, the women got a sense of caring and individualised attention from the HLWs. Most women felt that they were given adequate time (about 10 minutes average) talking to the HLWs on MSSM, which was not usually the case at the health facilities, due to overcrowding of patients.

Sometime we go to the clinic, you find this doctor who is unapproachable and you even fail to express yourself because of fear . . . In contrast, the person you talked to on the phone made you feel so comfortable that you were able to express yourself freely. (Mother-5)

The women perceived MSSM to be confidential in the sense that they could talk privately to someone they had never met and who was able to help them with their problems. Most women said that *“Whatever is discussed will be between me and the doctor”*, and some of the women were confident that they could talk about sensitive issues that only MSSM, and no one in the community, would know about it.

7.4.6 Summary of Middle Range Theory 2

In mHealth interventions offering educational health information and clinical referrals to women in maternal healthcare, the rapid access to health workers and health information can be useful to the women. Convenience of services and economic benefits (e.g. time, and financial resources savings) have a huge impact on perceived usefulness. The women valued the enhanced meaningful interaction with health workers through the system and at local health facilities. Further, confidentiality, quality health information, and quality services enhanced perceived usefulness of mHealth services. Therefore the hypothesised proposition that *if mHealth intervention is perceived as more useful than other maternal care options in an individual’s social system, women are more likely to use the intervention to solve maternal health problems*, holds in the case of MSSM. The MRT is summarised as follows:

Service convenience of mHealth in terms of immediacy, financial resources and time savings, interaction with health personnel, quality of information and services, is perceived as more useful than other maternal care options in low resource areas. This encourages women to use the mHealth services to solve maternal health problems.

7.5 MSSM alignment with local realities

MSSM compatibility with some pregnancy values of the local communities enhanced adoption of the services; however, overlooking some of the cultural norms and beliefs resulted in negative effects. Themes that emerged from the data relating to compatibility of MSSM with the local realities were:

- a) Perceived privacy

- b) Gender sensitivity
- c) Expectations of recompense
- d) Exclusion of traditional maternal care system

7.5.1 Perceived privacy

During their training, Community Volunteers were strongly advised to respect the privacy of the women, since maternal health is a sensitive topic in Malawi. The Community Volunteers operated the phones for those requiring help, and left them to talk in private once they were connected to the system. For the women who knew how to operate the phone, the Community Volunteers simply availed the phone to them and left.

... they [HLWs] told me not to talk in public when I am talking on MSSM . . . When I go to the volunteer's house or if she comes here, she gives me space to talk where I am all alone. (Mother-7)

The women also perceived the use of a password to retrieve voice messages as a way of securing messages which they considered personal. Even though the password was meant for identification in MSSM, it was perceived as a privacy and security feature by the women using shared phones: “... once I key in the secret number; they know it's me and give me my messages . . . and only me can listen to them” The majority of women using shared phones preferred voice messages to text messages because anyone could read them and some women felt that their privacy would be invaded.

I used to get messages on my mother's phone . . . what was happening is that she could open my message, read it first and then give it to me. Sometimes she could tell me that I received a message from MSSM but someone was playing with my phone and it got deleted. (Mother-1)

Some women, however, doubted that the intervention upheld privacy seriously and this discouraged them from enrolling or using the services. Some women were shy to go to the Community Volunteers, thinking the Volunteers would listen in on their conversation.

7.5.2 Gender sensitivity

Maternal care being a gender-sensitive domain, recruiting male Community Volunteers discouraged some women from using MSSM services. Middle-aged women (30-50 years old) undermined the Community Volunteers, especially young men. These women felt that they could not talk about pregnancy at the house of someone younger than them. In Malawi it is taboo for a young person to listen in on a conversation about pregnancy. Furthermore, in Malawi as in most developing countries, maternal issues are dealt with exclusively by women (Lori & Bolye, 2011; Seljeskog et al., 2007). Thus, pregnant mothers were uncomfortable interacting with male volunteers and HLWs.

I was shy and uncomfortable when I found that the doctor on the other end of the phone was a man, I failed to speak about the problems I was facing . . . but they were quick to pick it that I was uncomfortable . . . and encouraged me to be free and talk about any problem I was having.... (Mother-2)

Where the Community Volunteer was a man, some husbands would not allow their wives to use the services. In contrast, where the volunteer was a woman, the mothers were free to talk on MSSM, even in their presence, and were confident that they would keep the pregnancy details private.

7.5.3 Expectations of recompense⁸

The project faced challenges in managing the expectations of the community stakeholders (the women, Community Volunteers, HSAs, and the local facility health workers). While the project offered no material incentives, most of the local participants expected to be compensated for their involvement. Other projects, even from the same implementing agency, working in the same piloted catchment areas, provided their participants with incentives of various kinds. This created expectations among the community stakeholders

⁸ Some of this work on incentives and exclusion of maternal care systems was published in Nyemba-Mudenda & Chigona (2013). Stakeholder management in a community mHealth initiative in Malawi. *Journal of Health Informatics in Africa*

that they would receive similar incentives such as money or mobile phones. Thus, some women found the MSSM less attractive because it did not provide material incentives.

Women here are not interested in MSSM because they do not give anything . . . they say that it is not useful, it could have been better if they were handing out money
(Mother-6)

The implementing agency did not mention upfront about not providing incentives and they also failed to clarify the speculations. Regarding Community Volunteers, being a point of contact for the implementing agency, women suspected that these volunteers received monetary incentives from the project implementers but did not share with them. This affected trust between the volunteers and the women, which was crucial for continuation of MSSM use.

... people think Community Volunteers receive a lot of money from the implementing agency and they insult them for not sharing . . . when they try to reach out to some women they are told that 'do not bother us with your programme, you receive a lot of money on our heads and you do not share.' (HSA-1)

Some women stopped using the services when they realised there were no material benefits. This also led to attrition of Community Volunteers. Similarly, HSAs and health workers lost interest in the project, resulting in them not assisting the women properly.

7.5.4 Exclusion of traditional maternal systems

Elderly women are custodians of maternal care systems in rural communities; they are brokers of maternal care information and act as mentors to young women (Maimbolwa et al., 2003). However, they were not involved in MSSM activities; thus, the intervention overlooked the local traditional maternal care ecosystem. Consequently, the elderly women viewed the intervention as something that had come to eliminate their tradition. As a result, they influenced the decisions of the pregnant mothers on using MSSM services and/or acting on the information received in a negative way.

I heard of MSSM from my friends when I was six months pregnant. My mother knew all about MSSM and she even knew the Community Volunteer in our village but she never told me about it. She said that I raised you up by myself without help from MSSM and I can therefore tell you anything you want to know about pregnancy. Later on she gave me details about MSSM and I joined . . . But when time for delivery came, my mother took me to the nearby TBA.... (Mother-1)

The elderly women exhibited resistance and negativity towards the intervention. This contributed to some women being sceptical and non-receptive about the intervention and maternal healthcare in general. Leaving the elderly women out of the MSSM ecosystem was a setback to the intervention, as it discouraged the women from registering and/or using the system.

7.5.5 Summary of the Middle Range Theory 3

The MSSM intervention was attuned to secrecy values surrounding pregnancy in developing countries and espoused the notions of privacy and confidentiality. The women found this valuable and were encouraged to use the mHealth services. However, MSSM failed to take into account some cultural norms about maternal care e.g. gender sensitivity. Furthermore, it ignored the custodians of maternal care in rural communities, the elderly women, who felt threatened and influenced pregnant mothers not to use the mHealth services. Additionally, MSSM did not take into consideration the culture introduced by other health interventions operating in the area e.g. providing material incentives to enhance the relative advantage of the intervention. This had a negative effect on the operations of MSSM and the adoption of the services. The proposition relating to a compatibility mechanism as conjectured holds in the case of MSSM and the MRT is as follows:

mHealth interventions are more likely to be adopted if they are consistent with needs of the consumers and are accustomed to the values and beliefs of local communities. In sensitive domains such as maternal health, when non-harmful socio-cultural ideologies pertaining to pregnancy care and traditional information systems are incorporated in the mHealth intervention, the intervention gains trust and support of the local people, and women are more likely to use the services and act on the information to achieve health outcomes.

7.6 MSSM system affordances

MSSM afforded the clients an opportunity to learn home-based and facility-based health practices (recall Figure 5-4). The analysis shows that the system had impact on spouses, as well as other women who were not using MSSM. Thus, MSSM contributed to a change in the belief that maternal healthcare was an issue for women only, and encouraged male involvement.

7.6.1 Learning health practices

The knowledge gained from interacting with MSSM resulted in a paradigm shift for most women. The women were able to follow through the development of the pregnancy and would know what was involved at different stages of pregnancy. The knowledge gained helped the mothers know what to expect and also how to prevent and resolve trivial ailments. The personalised care from MSSM and reflections on how the information, if applied, worked in their lives, engendering a shift in the women's thinking, practices, and beliefs.

Before I started ANC I got sick . . . I was getting contractions and I was scared that I was going to lose the baby . . . So we called MSSM. And they told me that I should stop doing hard work, and not walking long distance . . . but I did not heed to the advice because I did not see any connection between walking long distance and stomach pains . . . so one day I walked a very long distance . . . before I could reach home the pain in my stomach started . . . then I realised that what MSSM say may be true. If I had not joined MSSM I would have wasted my money going

to a traditional healer, and also starting hating some people thinking they are bewitching me (Mother-FGD2)

Receiving health information that corresponded to the gestational age was a practical hands-on learning that changed the women's beliefs about pregnancy. Previously, the women would attribute things they did not understand to witchcraft. The learning process was transformative in such a way that it changed the attitudes, beliefs, and behaviour of the women. Transformative learning involves construction of knowledge where the learner actively and critically analyses both their own experience and alternative solutions, in order to construct their own strategies to deal with everyday problems (Aubel, Touré, & Diagne, 2004; Mezirow, 1997, p.950). Transformation in this perspective is defined as:

The process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand, and feel about our world; changing these structures of habitual expectation to make possible a more inclusive, discriminating, and integrative perspective; and finally, making choices or otherwise acting upon these new understandings (Mezirow, 1991, p.167).

The messages from MSSM changed the women's frame of references and understanding. The knowledge helped the women to make informed choices in maternal health, and some were able to act on the new understandings.

The women felt the practical knowledge they gained was likely to be retained for a long time. Almost all the women recalled the last message they received, and were confident that next time they encountered similar problems they would know what to do at home by themselves. Some were confident enough to share the health practices and solutions with their families and friends.

MSSM clients demonstrated good knowledge of maternal healthcare at health facilities compared to women not using the MSSM; they were understanding and cooperative patients. One nurse described them this way:

With women using MSSM you find that a lot of what we teach them, they already know about it, they have heard it before, as such they are interested and

understand easily . . . They ask meaningful questions and can add on some of the things we say . . . And they answer questions properly and also demonstrate that they understand the importance and benefits of these things. (HW-1)

The women asked questions when they were not clear and commented on some issues they felt they knew better about. This is not usually the norm in rural parts of Malawi. Additionally, it was easy for the women to understand the facility services offered to them and they would comply without difficulty to requests and suggestions made by health workers.

7.6.2 A paradigm shift in male involvement in maternal health

Male involvement in maternal care was another area where the paradigm shift was evident. Previously, most men did not appreciate the benefits of getting directly involved in maternal care and accompanying their wives to the ANC. Since most women using personal phones for the intervention used their husband's phone, they would listen to the messages together. Similarly, when a husband received a text message he would read it first before showing it to his wife. Generally, married women using MSSM shared with their husbands the messages or medical advice.

I share with my husband every message I get. Sometimes he actually asks me if I had gone to listen to my messages. He looks forward to know more of what is happening with the baby. (Mother-12)

Consequently, men benefited from MSSM services as well and gained maternal health knowledge, leading to participation and support in maternal issues. One woman said “... *it is teaching us good practices in marriage, how both partners can be involved in the pregnancy*”. In health facilities it was observed that married women referred by MSSM were usually accompanied by their husbands. Some men could go to the clinic to verify what their wives had been told on MSSM.

7.6.3 Summary of Middle Range Theory 4

In rural areas, women have adequate maternal health knowledge but this does not translate into improved health outcomes, due to lack of practice. If a consumer seeks information or a solution from a need to resolve a health problem, mHealth services, with practical information that is time-specific and personalised to the circumstance or experience of the consumer, makes it easier for them to try and validate. This experiential learning changes women's frames of reference and facilitates choices, based on informed decision-making, which usually results in acting on the new understanding. It is not just about acquiring knowledge on maternal healthcare, but the reliability of the practical information that corresponds to the condition and experiences of the women in meeting the needs at hand, that enhances the adoption of home-based and facility-based practices to improve health outcomes in maternal healthcare. The resulting MRT holds as follows:

Acquiring timely, reliable and practical information from mHealth interventions tends to increase adoption of home-based and facility-based health practices. This enhances patient empowerment and engagement that improve maternal health outcomes.

7.7 Agency of the mothers using MSSM services

ICT has the potential to contribute towards improved health outcomes. However access alone does not guarantee improved health outcomes; what matters is what people do once they obtain health information or have access to health services (Coeckelbergh, 2011). Individual agency is vital to the process of achieving health outcomes after gaining maternal health knowledge. In this study, agency refers to a mother's ability to pursue and realise goals she has reason to value, while health agency denotes a mother's ability to achieve health outcomes she values and to act as an agent of her own health. The analysis showed that self-efficacy, choice, and acting on opportunities were interwoven within health agency. Self-efficacy reflected a mother's confidence to overcome the difficulties inherent in performing a specific task or action in a particular situation to achieve health outcomes. Consequently, self-efficacy influenced choice of actions to be carried out to achieve intervention outcomes e.g. giving birth at a health facility; also the inhibition of existing

undesirable behaviours e.g. giving birth from home. These three agential mechanisms are discussed in the following sections, from the perspective of diverse activities that the women had an opportunity to engage in, from the health capability set enabled by MSSM.

7.8 MSSM contribution to health capabilities

This study espouses to the definition of empowerment as “enhancing a woman’s capacity to make effective choices and translate these choices into desired actions” (Alsop & Heinsohn, 2005, p.5). Health information and advice from MSSM empowered the women to make informed choices in maternal health and translate the choices into activities they valued to achieve health goals. Some of the women using MSSM went through a process of empowerment and achieved a variety of functionings that led to improved health outcomes, while others did not, due to contextual dynamics. The women carried out diverse actions to achieve health goals they valued, as depicted in Table 7-5. Self-efficacy mediated the choice of activities to engage in and choice determined a particular activity to be carried out to achieve health goals under the influence of contextual factors.

Table 7-5: Enabled health capabilities

Capability	Activities /States
To be healthy	<ul style="list-style-type: none"> - Adopting home-based and facility-based health practices - Seeking healthcare services in good time - Managing complications before getting to a health facility - Having fewer complications - Planning and preparing for childbirth - Giving birth at a health facility - Having postnatal check-up - Having health pregnancy and a healthy baby

For instance, some women were able to plan and prepare for childbirth and delivered from a health facility, while others could plan and prepare for childbirth but not manage to deliver from a health facility; yet others would fail to plan and prepare for childbirth and deliver from home, all due to contextual dynamics.

7.8.1 Adoption of home-based and facility-based practices

The knowledge gained on maternal healthcare empowered the women to:

- i. Take responsibility for health decisions.

- ii. Act on some decisions in their communities.
- iii. Change some of their behaviour to improve health outcomes.

This transformation was facilitated by adoption of home-based and facility-based health practices (refer to Figure 5-4).

Gaining knowledge on the importance of disease prevention and sanitation practices in pregnancy and at home in general, increased the women's confidence in putting them into practice. For instance, the women used mosquito nets and kept their homes clean. Evaluation data from the implementing agency indicated that the use of mosquito nets in the piloted areas increased by 25%, compared to other areas used as a control group.

The nutrition advice was based on food that could be locally found. Some women followed the advice and kept healthy. Family support and provision increased the chances of a woman adopting a nutritious diet. Low-income status was the main factor impeding the adoption of a nutritious diet in pregnancy for the women. Most women lacked basic resources at home and could not afford three meals a day, nor make sure that the meals were nutritious. In view of this, most women could not manage to put the nutrition advice into practice, which affected their self-efficacy and choice to adopt healthy diet.

... sometimes we could go for two days without eating . . . completely having nothing in the house . . . with that I knew that this pregnancy would have problems. (Mother-9)

Consequently, women would give birth to pre-term or under-weight babies. The lack of resources affected the women in achieving their health goals in so many ways. In some women, the lack of resources was exacerbated by marital problems such as polygamy and separation. Polygamy was the norm among the tribes in the pilot catchment areas; most husbands would leave their wives when pregnant for another woman, putting an extra burden on the limited family resources. Further, there was a tendency for men to leave for urban areas or other countries to seek financial opportunities; they often left their wives pregnant and never came back, nor offered any support. Most of the women left behind had low levels of education and did not have a proper source of income; thus, fending for

themselves and the children was a huge challenge. This affected them sociologically and psychologically to care about the pregnancy or the new baby to be born.

Doing heavy jobs was found to be the main cause of most basic illness and discomfort in pregnancy. Some of the women heeded the advice of not doing too much work while pregnant, and sought help from family and friends. However, others could not, especially because, as per culture, a couple stayed with the husband's family, and the women were expected to do most of the chores. Some women using MSSM were still doing too much work and too many heavy jobs, despite the advice they got from MSSM.

I still have to do all the house chores at home, going to fetch water; I pound my own maize flour. It is really cumbersome and tiring but what can I do . . . these jobs bring pain in the lower abdomen which clearly shows that they affect the baby. (Mother-5)

The same applied to the use of traditional medicine and seeking medical services from the clinic; if the family had a negative attitude based on cultural beliefs of witchcraft, secrecy, traditional rituals, and religion, a woman would simply comply out of fear or respect. Most women could not start ANC early during the first trimester due to fear that people would know about their pregnancy and cast a spell on them, causing a miscarriage. As such, they would choose to start attending ANC when the pregnancy had advanced, missing out on important routine care provided at ANC. With such culture inherent in the communities, some women could not go to a health facility; in addition, they needed permission from the family to seek medical care, which was not usually granted even if the women wanted to seek medical care as individuals. Further, the culture of staying with in-laws was problematic with HIV testing at the first ANC visit. Women who tested positive would be discriminated against by the husband's family, and that might end in divorce. Consequently, testing for HIV at the first ANC visit discouraged most women from attending ANC or return for follow-up visits.

Nevertheless, improvement in the use of maternal health facility-based practices was noted in all piloted health facilities. The number of women starting ANC in their first trimester and the overall number of women attending ANC increased to some extent. The knowledge

about the importance of attending ANC that the women gained encouraged some to seek the prenatal services, even those who believed they were not capable before.

Before joining MSSM I used to tell myself that when my husband finds enough money I will start ANC. When I registered they asked me if I had started ANC already. They told me to start and all the benefits of starting ANC early but still I did not start. In my first message they advised me to be taking iron tablets and how this benefits the baby. And I could get iron tablets from the clinic . . . so even if the clinic is far from my village I was encouraged to start going for ANC because I wanted to get the iron tablets, prevention treatment for malaria and receive a mosquito net to protect me and the baby. If I had waited for my husband to find money and not pay attention to the messages from MSSM I would not have done myself justice. (Mother-12)

The understanding of the benefits that came with prenatal services increased the confidence of the women to attend ANC amidst the prevailing constraining factors. Some women started ANC on time and attended for the minimum of the required four visits. However, the long distance to a health facility and lack of money for transport affected the women's perception of the ability and decision-making in seeking prenatal services. The women also lacked basic commodities such as toiletries, and they would not go to ANC or would delay in seeking healthcare because they had no clean clothes to wear and/or could not afford soap for bathing. Despite all these challenges, some women managed to seek medical care.

7.8.2 Seeking healthcare services in good time

The clinical referrals encouraged many women to seek healthcare in good time. Women with complications who required medical attention were strongly advised to go to the clinic without wasting time. Even the women given advice to resolve trivial problems at home were advised to seek medical attention immediately if advice did not work. MSSM also advised the women on the availability of resources, at the local health facility, required for their condition. This service was meant to save the women time and resources by advising them to go to a health facility for the required treatment. However, it was not effective and

did not benefit the majority of MSSM users, due to the technical and operational issues discussed in Section 7.10.

Behavioural change in seeking care was evident in all four health facilities, and the number of women attending with trivial problems had reduced. As a result, the health facilities could channel their time and resources to patients with serious conditions:

People do not wait for a condition to get worse for them to come to the clinic, they are coming here in good time and we are able to help them properly. The tendency of receiving very sick children or pregnant women has reduced. (HW-3)

Seeking medical care in maternal health gave the women confidence to use health facilities for other health problems. It was noted that being the caretaker of the house, a woman's knowledge to seek healthcare in good time also encouraged other members of the family to seek healthcare from health facilities. This increased the numbers in the out-patient department for the already over-burdened facilities. The perception that they talked to real doctors on MSSM gave the women confidence to go to a health facility and engage with health workers, something they had previously feared. Further, community respondents believed that the health workers treated those women who had been referred to a health facility by MSSM, better than others. This encouraged the women to seek medical services on MSSM first.

In addition to the impeding factors discussed in the previous section, some women were discouraged to go to a health facility because of the negative attitude of health workers. Some women would look forward to seeking medical help from a health facility after being referred by MSSM but, once they got there, they found staff that was unapproachable and difficult to engage with, and would be rushed through a consultation without being given a chance to express themselves, such as:

Sometimes they [the women] come here to the clinic and they do not get that much help, they come here and meet a nurse who is not willing to do her/his job, maybe he or she is tired. And yes some nurses do shout and insult clients, and people go home sad and complaining. (HW-4)

This would decrease the women's confidence in seeking medical care and they were demoralised. Consequently, some would choose not to go to health facilities and instead use other options such as TBAs. In some cases women were neglected and treated harshly when they sought healthcare, even in critical situations like childbirth.

7.8.3 Management of complications in maternal health

MSSM services helped the women to manage complicated maternal health conditions in two ways.

- a. Minor problems arising from ill practices that could lead to serious complications got resolved timeously, and later prevented, by following MSSM advice.
- b. The women got an initial assessment of their health condition via MSSM; this encouraged them to seek medical care before a condition got critical.

In some cases women would call MSSM, thinking it was a small issue that could be resolved at home, while it was actually a serious condition. These women would be advised to go to the clinic immediately before the condition got to a critical stage. In case of a serious complication, advice was given on how to manage the situation as they were going to the clinic. The information from MSSM increased the self-efficacy of the women in dealing with the complications at home or on the way to the health facility. It would encourage them to engage in whatever advice was given by MSSM. This increased their confidence in the help they could get from the health facility, and they would choose to go to a health facility the next time. However, in some cases, contextual factors would be restricting. The management of complications at home and on the way to a health facility reduced the number of serious complications received at health facilities, as well as reducing serious complications that could lead to maternal deaths.

7.8.4 Planning and preparation for childbirth

Previously, MSSM pregnant mothers did not know their EDD; labour would usually take them by surprise. MSSM helped the women to know with certainty the period around which they would give birth. Close to the time of delivery, women received reminders of the

necessities required for childbirth at the clinic, because health facilities did not provide anything. MSSM also encouraged the women to plan for transport to the clinic, and arrange for childcare at home. Even those women whose EDD was not near, when they called MSSM with labour-like symptoms, would be advised to go to the clinic prepared for delivery, and some would actually give birth early.

Some could not afford to buy everything as advised, due to low income. Consequently, most of these women would choose not to give birth at a health facility to save themselves embarrassment among other women, and also in fear of the health workers shouting at them for not meeting the requirements. On the other hand, the planning information helped some women with their planning and saving skills, and it increased their self-efficacy in delivering at health facilities. The capability to get some of the requirements needed for delivery at a health facility gave some women confidence to deliver at this health facility, knowing that health workers would not insult them. The planning also reduced pressure on the health workers in dealing with women coming for delivery without the essentials. Ultimately it resulted in an increase of the number of women giving birth at health facilities, and a reduction in the number of women giving birth on the way to the clinic.

7.8.5 Giving birth at a health facility

At the time of data collection, the number of women delivering at health facilities had increased, with a few cases delivering on the way to the clinic or at TBAs. A District Health Personnel said, *“We used to have on average about 10 women every day waiting for their time but now that number has increased to 50 women every day waiting for their time.”* A woman’s decision to give birth at a health facility was influenced by a myriad of socio-cultural factors. Community leaders supported the presidential initiative in Safe Motherhood that encouraged all women to deliver at a health facility, by putting in place policies for women to comply with, or pay a fine. The women with low income status and lacking in many ways, were therefore persuaded to deliver at a clinic.

Nonetheless, with health facilities situated far from most villages, poor transportation systems and lack of transport money decreased the confidence of women to deliver at a

health facility. As such, some women still chose to deliver either at home or at the TBA's home. Although MSSM unlocked the potential for women that could be actualised by giving birth at a health facility, contextual dynamics affected the women's confidence and choice to achieve this health goal. The factors pertaining to the health facilities that affected the women's behaviour to seek medical care especially in childbirth are discussed in Section 7.9.

7.8.6 Having a postnatal check-up

The women were sensitised about the importance of giving birth at healthy facilities, including management of major complications under skilled care and access to a postnatal check-up, which is necessary in the first 24 hours after delivery. This encouraged some women to choose giving birth under health-skilled attendant supervision, and having access to postnatal services, which resulted in improved health outcomes for mother and baby:

We have seen a decrease in the number of women coming with infections or babies with infections in the first month after delivery now that most women are delivering from here. These have decreased because we do provide prevention services for infections that can attack the mother and new-born baby after delivery . . . We had high numbers of these some time back. (HW-2)

The evaluation reports showed that in the piloted area, postnatal check-ups had greatly improved in the two days after delivery. The benefits of a postnatal check-up were evident in mothers and babies even in the first month after delivery, as infections had reduced. The whole process of adopting a healthy lifestyle during pregnancy, delivering at a health facility, to the point of utilising postnatal services, enabled the women to have healthy pregnancies and give birth to healthy babies – which was their ultimate goal. Heeding the advice given and acting on a combination of the different functionings led to the achievement of this goal. Some women experienced a healthy pregnancy and delivered healthy babies, while others did not, due to contextual mechanisms.

7.8.7 Summary Middle Range Theory 5 & 6

The women engaged more in activities they perceived they could accomplish and avoided those they believed exceeded their capabilities. Self-efficacy and choice were specific to a

particular activity or task and the circumstances that surrounded it. Both self-efficacy and choice as mediating mechanisms were influenced by opportunities, obstacles, and resources in a mother's environment, which also determined the means by which actions were carried out and their outcome thereafter. Low self-efficacy decreased the confidence and likelihood of a woman to choose from the opportunities generated by MSSM the activities that would help to achieve a healthy goal, even if they had a desire for a healthy pregnancy and healthy baby. Failure to act on the health information, thus enacting the opportunities, led to unachieved intervention outcomes and, ultimately, unfavourable health outcomes. The summary of the MRTs is as follows:

High degree of self-efficacy tends to increase the likelihood of a woman to adopt and use mHealth services in maternal healthcare.

Self-efficacy mediates the choice of activities that women engage in to achieve health goals in maternal healthcare; high degree of self-efficacy tends to increase the likelihood of a woman choosing to enact on opportunities enabled by mHealth interventions to achieve health goals.

Activation of health information is determined by the choice of activities that women choose to engage in. Acting on the opportunities in one's capability set generated by mHealth intervention tends to increase the likelihood to achieve one's health goals and improve health outcomes.

7.9 Complementary maternal healthcare resources at health facilities

The health facilities in the piloted catchment had a myriad of challenges for day-to-day operations to serve the communities efficiently, and were found lacking in resources to provide adequate care in maternal health. So, even if women would seek medical intervention in time, some could not get adequate treatment as required, and consequently failed to realise their health goals, due to malfunction of the health system. The contextual factors prevailing in the health facilities included:

- i) Inadequate drugs and equipment
- ii) Poor conditions at health facilities
- iii) Shortages of staff

Poor conditions at health facilities cover areas of poor referral system, poor condition of waiting areas, limited space for admission, and no provision of food to admitted patients.

7.9.1 Lack of drugs and equipment

There were shortages of drugs for prenatal care or drugs needed in labour ward. *“... it was possible for someone [a pregnant woman] to attend ANC to the point of giving birth without receiving iron tablets”*. Some women attended ANC for the whole period of pregnancy without receiving the required supplements, prophylaxis, and immunisation. Even instruments and equipment for diagnosis and treatment were not sufficient, as indicated by one nurse: *“Sometimes they come here and they find that we do not have resources like gloves, and it is hard to help them....”* Limited resources affected the time it took to help a client because health workers took turns in sharing equipment, resulting in patients staying longer at a health facility than necessary.

7.9.2 Poor conditions at health facilities

A poor referral system contributed to women losing their lives or their babies, due to unreliable emergency transport services to take women to the district hospital, in the case of a serious complication. Ambulances at the district hospital were rarely available and most bicycle ambulances at health centres were not working. A participant was kept at a clinic for more than 12 hours waiting for an ambulance and ended up giving birth to a stillborn baby. In some cases, patients had to buy airtime for health workers to call for an ambulance for them. Usually an ambulance took several hours to reach a health facility, mainly due to poor logistics. By the time the patient got to the main hospital, the condition could have worsened, resulting in the death of the mother, or the baby, or both.

The waiting areas at health facilities were not in good condition. In some health facilities the waiting area was an open space with a shed, thus women slept outside waiting to give birth. In other facilities it was a room with no furniture; the women slept on the floor. The poor condition of waiting areas contributed to women still delivering at home or at the TBAs. Some women preferred giving birth in the comfort of their home using traditional practices

rather than delivering at a health facility under the supervision of skilled health personnel but in uncomfortable conditions.

Women also failed to access required medical care services due to inadequate space and beds for admissions in some health facilities; it was impossible to keep patients for observation after delivery or for a serious complication. So, even if women decided to seek medical intervention, they could not receive adequate care because there was no room to keep them for observation. *"... so you find that after women have given birth instead of keeping them in for observation we discharge them to go home because we do not have beds for them to sleep in."* Thus, women would be sent home without completing treatment or undergoing a postnatal check-up.

Besides government clinics' services being free of charge, they did not provide food for admitted patients. Patients had to cater for themselves. The perception in the communities was that one needed money for food to stay at a health facility; this was a challenge to many, due to low income status. A nurse said that *"You find that a woman has come to wait for delivery but has no food to eat . . . it is a sad and difficult situation."* Some women would choose to give birth at home because they did not have enough food to take to the clinic and leave some for home.

7.9.3 Shortage of staff at health facilities

One other main factor affecting quality of maternal health services was shortages and attrition of human resources. All the health facilities were under-staffed and the few available personnel were overworked. This resulted in long queues and delayed services for the patients.

... as you have seen in the ANC we only have one nurse on duty . . . that one nurse attends to women in need of family planning services, the very same nurse attends to women who have come for ANC and she is the same one helping women in the labour ward . . . these staff members work all day long and they are the same ones dealing with emergencies in the night and continue again in the morning.... (HW-3)

Three health workers were serving a catchment area of about 56 000 people. The shortage of staff led to delay in services at health facilities. The delay in services discouraged women from going to the clinic; they spread the news in the community, discouraging other women as well. This also contributed to the unfavourable relationship between health workers and the community.

7.9.4 Summary Middle Range Theory 7

Lack of resources contributed to poor quality of service in maternal health and inadequate care for the women. This affected the communities' perception of MSSM. To the community, MSSM services proved to be less meaningful and helpful to the women, because the MSSM project simply provided the women with health information and referral services to the clinics. But there were insufficient resources in all health facilities for adequate healthcare, and resources are crucial to improving health outcomes. Consequently, the lack of resources in healthcare would eventually make clients lose trust in the health system and MSSM services; they would go back to their old practices. Hence, the following MRT:

Poor quality of maternal healthcare services due to poor infrastructure and lack of resources at health facilities tends to reduce the effectiveness of mHealth intervention in improving maternal health outcomes and this affects the uptake and continual use of mHealth services.

7.10 MSSM and system integration

MSSM was not fully integrated into the district health system. It operated independently and consequently failed to engage all health workers who were central to project success and effectiveness. The implementing agency involved some health personnel at district level in developing the messages, in quality assurance of the services, and in some awareness campaigns (recall Section 5.4). The District Health Officer, as the principal government representative, had minimal involvement in the project; as such, it was less likely that government would take ownership after funding had run out. In addition, the four local health facilities were only involved in receiving the referred women for treatment and promoting the intervention during health talks.

7.10.1 Lack of inter-organisation collaboration

HSA and local health workers were not officially involved in MSSM. This resulted in uncertainties of roles and responsibilities, and high expectations. The health personnel in local health facilities expected to be involved in communication between the women and the implementing agency. The limited interaction between health workers and MSSM resulted in local health facilities' personnel having inadequate knowledge about the health information services offered to the women. Neither the implementing agency nor the district hospital passed down this information to community health facilities. This could be attributed to the weak two-way communication in the health information system of Malawi; the system is mainly bottom-up with inaccuracies (Kanjo, 2011). Health workers' inclusion in MSSM operations could have been useful in:

1. Situations where women sought clarifications at health facilities on issues they heard from MSSM
2. Saving time during referrals for serious complications
3. Planning in health facilities for effective service delivery

Despite MSSM checking on health facility resources weekly, HLWs still referred clients to health facilities without the necessary resources, due to lack of appropriate and regular communication. Furthermore, the poor communication and coordination in tracking of referrals resulted in patients getting different opinions and they ended up confused; consequently they lost trust in the health system. Since the community had trust issues with the health system initially, the women believed more of what they were told on the phone than what health workers were telling them.

Sometimes you find that we tell the client different information, and the clients actually say that 'that's not what they told me on MSSM' and the clients usually think that us the health workers we are the ones telling them wrong information and that we are not helping them adequately. (HW-2)

The women felt that health centre personnel were less knowledgeable than HLWs and that they did not help them adequately because they did not understand their ailments.

The lack of collaboration affected monitoring and evaluation of the impact of MSSM on reduction of MMR in particular. Since the health facilities did not have any information on the number of women MSSM was reaching in the community, and also of the women referred to the clinic by MSSM, they could not account for its contribution toward the reduction of maternal morbidity and mortality rate.

Some women do not even say that they have been referred by MSSM; as such we do not have proper figures of the women sent or encouraged by MSSM to come to the clinic. The data can help us to know if MSSM is really helping. (HSA-4)

A formal collaboration with health facilities could have involved HSAs to follow up on the women using MSSM services in their areas, to assess how they had been helped with the information received. This could have helped with monitoring and evaluation, and feedback on the effectiveness of the services. The feedback loop in MSSM was weak (refer to Section 5.6). HSA's involvement could have strengthened the monitoring and evaluation system by keeping records of the women helped in the community and providing feedback to both the health facility and implementing agency.

7.10.2 Summary Middle Range Theory 8

The main theme under system integration was lack of collaboration between the implementing agency and the local health facilities, which was exacerbated by the lack of information flow between the district hospital and the health facilities. Further, MSSM was not incorporated into the existing health information system. This engendered inconsistencies in the information services offered to the women, contributing to patient dissatisfaction and loss of trust in health facility services.

The local health facilities were not involved in the planning and designing of the intervention, albeit being clinics that offered maternal health services to the women. As a point of contact with the communities, local health workers' contribution to the project planning and design in a formal way could have improved project operations to serve the women better. Unclear responsibilities resulted in speculations and high expectations of the project (e.g. expectations of incentives), which led to attrition of health workers when they

were not met. MSSM in general, had minimal participation of government through the MoH; that is why, after a year in operation, the implementers were not sure of government's stand in regard to the project. Thus, involvement of health personnel at all levels necessary for mHealth implementation would help with activities that best serve the communities and facilitate government buy-in. The MRT specific to MSSM was adapted as follows:

Inter-organisation collaboration and integration of mHealth into the existing health system tend to improve access to health information and services that enhance efficiencies and health outcomes in maternal health.

7.11 Unintended consequences of MSSM services

There were some unintended consequences of MSSM services. As noted by the health workers, on one hand, when MSSM had just started, pregnant women were treating every case as an emergency when referred by MSSM. Even those with a basic illness would go to health facilities with a sense of urgency. The women would think that their condition was critical just because they were told to go to the clinic immediately. Some women would go to the clinic late in the evening or at night with cases that could have waited till the next day. The problem was lessened when health personnel from community health facilities communicated to the implementing agency to counsel women properly and not instil fear.

On the other hand, some pregnant women were over-relying on MSSM even in critical conditions that needed a quick trip to the clinic. Some women got so attached to MSSM, to the point of over-reliance. Even with cases showing danger signs e.g. losing blood, where they needed immediate medical intervention, some would want to wait until they had talked on MSSM.

When I fail to get through to MSSM, I just go and wait at home to try another time . . . and you find the problem getting worse . . . and then I will just think to myself that its better I go to the clinic.... (Mother-2)

The challenge was that MSSM only operated 12 hours in a day; furthermore, the system would also be unavailable, due to poor network and system outages.

Lastly, MSSM users expected to be assisted before others who went to the clinic before them; but health facilities kept to ‘first come first served’ method. This was a challenge since the health system in Malawi does not deal in appointments. When the health facilities refused to treat them with preference, some MSSM clients got frustrated and disillusioned about the system. The ‘first come first served’ method in the Malawi health system was partly the reason why the booking system did not work.

7.12 Self-development capabilities

In addition to health capabilities, some basic human capabilities were generated for MSSM. The use of the mobile phone in maternal health also generated self-development opportunities for the women. The self-development capabilities manifested in the form of: being self-confident, being expressive, and being modern; as depicted in Table 7-6.

Table 7-6: Enable Self-development Capabilities

<i>Capabilities</i>	<i>Activities /States</i>
To be self-confident	<ul style="list-style-type: none"> - Engaging with health workers without fear - Being self-reliant – not having to rely on others e.g. elderly women for maternal information - Feeling assured about their pregnancy - Feel comfortable using mobile phones
To be expressive	<ul style="list-style-type: none"> - Talk freely about pregnancy and childbirth - Being open to talk about other issues in their lives
To be modern	<ul style="list-style-type: none"> - Being advanced - Being part of the civilised world - Perceived enhanced social status

The women were self-confident since they could use phones on their own. The women became empowered with the health messages and could engage with health workers with confidence, to the point where they could ask questions and even challenge health workers. Having knowledge in maternal care also increased their self-reliance. Some women reduced their reliance on elderly women for maternal care information. Some even shared what they were learning from MSSM with the elderly women. In addition, the women had a sense of security, having the confidence that their pregnancy would end up in delivering a healthy baby.

The knowledge gained and the experience of talking to HLWs, where they were afforded a friendly forum to express themselves on a rather sensitive topic, encouraged these women to be expressive, even at health facilities.

“It has also helped me talk freely about my problems . . . even when you go to the hospital you have to talk freely and explicitly how you feel so that they help you properly . . . you don’t have to be shy . . . or feel that maybe I am not supposed to say this.... (Mother-10)

Further, the women felt that they were part of the modern and civilised world by getting health information through mobile phones and they perceived their social status to be enhanced. One participant said *“... the use of phone is like a social thing in the villages, and they also value having a relationship with health workers. It is like something prestigious to be talking to someone on the phone from the clinic, they feel that their health is secure.”* Using MSSM was admirable among some groups of women because they believed that their social status in the community was enhanced.

7.13 Summary of the chapter

The chapter discussed the processes through which the women using MSSM realised the intervention outcomes and improved their health in pregnancy and childbirth. The attributes of mHealth technology, as they permeated the cognition of the women, gave them reasons to use the intervention. The beliefs that the women formed about the workings of MSSM included perceived ease of use, perceived usefulness, compatibility, and learning affordance. The women exercised their agency to achieve health outcomes which were mediated by self-efficacy, choice, and acting on opportunities. Complementary resources at health facilities and system integration also proved to be necessary conditions for the health system to deliver adequate care to the women using mHealth to improve health outcomes in maternal health. The mechanisms were enabled and restricted by personal, social, and environmental factors; which led to variations in outcomes among the women. The main focus of the chapter was on how mHealth helped the women to realise their health capability. However, it was found that MSSM intervention generated other capabilities for the women in the areas of information, economy, and self-development.

Some of these capabilities contributed to the perceived relative advantage of MSSM over other maternal care options and enhanced adoption and uptake of the services.

The next chapter discusses implications of the findings presented.

8 DISCUSSION

8.1 Introduction

The primary goal of this research is to investigate the pathway through which mHealth outcomes are produced for maternal health outcomes for consumers. The previous chapter analysed and substantiated the drivers of mHealth through which maternal healthcare outcomes are produced. This chapter attempts to answer the research questions, it discusses the findings of the study in relation to Capability Approach framework as an explanatory theory of mHealth in maternal health (McGrath, 2013). The chapter analyses the effects of mHealth on maternal health outcomes for the women, with reference to the relationship between mHealth and human capabilities. The chapter also looks at the necessary conditions for the observed effects: 'What needs to be present for the effects to occur?' (Sayer, 1992). Further, the chapter analyses the prevailing enabling and restricting factors that affect the realisation of both the mHealth intervention outcomes and maternal health outcomes. This chapter is divided into four sections. The first three sections are dedicated to each of the three sub-questions in Table 1-1. The last section gives a summary of the chapter by answering the main research question of the study.

8.2 Effects of mHealth on maternal health consumers

The findings indicate that MSSM had broader outcomes and implications than just an approach to enhance access to health information and services to improve maternal health outcomes. The effect of mHealth on women in the child-bearing age group, as consumers of maternal health, from the lens of CA, go beyond health benefits, and include intangible social effects that are fundamental for human development (Gomez & Pather, 2012). In this study, behavioural changes associated with mobile phone use were the intervention's outcomes that women realised from the opportunities created by the mHealth intervention. These outcomes were characterised by new information, decisions, new communication patterns, and new actions that affected maternal health outcomes and overall quality of life (Heeks, 2010; Kivunike et al., 2014).

Even though the study has primarily focused on the ICT capability input in the form of mobile phone use, there were other non-technical and non-material inputs that contributed to mHealth-related outcomes. The support from HLWs (e.g. mini system orientation for the women) and the provision of Community Volunteers in the villages intermediating phone access and usage, among other inputs, played a role in generating the capabilities. A combination of the capability inputs in the intervention generated the opportunities observed in the empirical domain. Consequently, disregarding one of the capability inputs can result in the removal of the opportunities that are dependent on it (Hatakka et al., 2014). The study found that mHealth contribution to capabilities and human development was in the following four different domains:

- a) Informational capabilities
- b) Health capabilities
- c) Economic capabilities
- d) Self-development capabilities

The following sections discuss these contributions, not only to further our understanding of the effects of mHealth on maternal health outcomes for the women, but also to explain the relationship between mHealth and human development.

8.2.1 Informational capabilities

In view of the low position of women in society in the developing countries, the use of mobile phones in health has the potential to enhance women's informational capabilities in terms of ICT skills, communications skills, and information capital. Through the use of mHealth services, women became IT literate as they gained knowledge on mobile phone use; this is similar to the findings on mHealth use among TBAs in Liberia (Munro et al., 2014). The findings show that these women, after gaining mobile phone skills, could use the phones, not only for maternal health purposes, but as an alternative source of communication with long-distance family and friends, to seek employment opportunities, and for business. Thus, the use of mobile phones and their networks expanded the

possibilities for connectedness for the women in relation to development resources (Smith et al., 2011).

Enhanced informational capabilities strengthened women's individual agency in terms of raising their awareness of existing health opportunities and the benefits offered in pregnancy and childbirth. The fundamental aspect of informational capabilities is information literacy; in this case, a woman's ability to collect, process, evaluate, use, and share information within her own socio-cultural context (Gigler, 2011). Information literacy and information capital of the women using MSSM were enhanced; they gained knowledge on home-based and health facility-based practices in maternal health. The women were empowered to resolve basic illnesses at home and to seek medical attention at the right time. The provision of time-specific information corresponding to gestational age made interpretation of information easier because it related to the experiences of a woman at that particular time (Osborn, 2013). The information richness of voice calls made it the most effective means of communication in maternal health in a developing country context, as it offered clarification on some information through direct interaction with HLWs, and provided immediate feedback (Daft & Lengel, 1986). Being informed consumers in maternal health gives women peace of mind; they feel secure about pregnancy, which contributes to their overall well-being (Ruger, 2010).

The analysis shows that, with improved agency, women can take responsibility of their health, make decisions, and change behaviour and attitudes rooted in cultural beliefs that are in opposition to health practices. Likewise, Lund et al. (2012) found that being informed consumers, engenders actions that comply with medical services, resulting in women receiving the appropriate care leading to positive maternal health outcomes such as increased skill attendance delivery. The fact that women were sharing information from MSSM indicates enhanced information capital and empowerment. The women had learnt sustainable health practices and solutions that they would use in future when faced with the same challenges. In addition, the health information can benefit the community at large through sharing.

This study found that sharing of information with husbands and elderly people in authority at household level increased men's knowledge in maternal care. Consequently, the men were able to offer appropriate support that reinforced women's agency in maternal health. This is in accordance with the findings of other mHealth studies in rural Ghana and rural Bangladesh (Huq et al., 2012; Osborn, 2013); inclusion of partners and other decision makers in maternal care increased both mHealth adoption and health facility utilisation. A dearth of male involvement in maternal health is one of the main factors leading to poor outcomes (Bowie & Geubbels, 2013). Men, especially husbands, as decision makers and authority over women in developing countries, lack and need information on maternal health to make informed choices for their wives.

mHealth increased the freedom for women to talk openly about maternal issues, even in the community. This has the advantage of early detection of pregnancy risks and critical symptoms to prevent maternal deaths (Lori & Bolye, 2011). Improved informational capabilities in maternal health consumers also enhance patient engagement. The women could interact with health workers in a meaningful and lucid way; this enhances women's confidence in and the uptake of facility-based practices and services (Lund et al., 2014a; Oyeyemi & Wynn, 2014). Thus, informational capabilities from the use of mobile phones create value for women in maternal health and can facilitate achievement of desired health goals in pregnancy and childbirth. It is through individual empowerment that the use of mHealth can enhance women's human well-being, even in maternal health (Gigler, 2011).

8.2.2 Health capabilities

mHealth services enhance the adoption of home-based and facility-based health practices that can decrease maternal morbidity, since women embrace a healthy life style in pregnancy and gain knowledge on managing basic illnesses at home (Huq et al., 2012; Oyeyemi & Wynn, 2014). Similar positive behavioural effects of mHealth services have been found in HIV/AIDS (De Tolly et al., 2012), TB (Nglazi, Bekker, Wood, Hussey, & Wiysonge, 2013) and malaria (Zurovac, Talisuna, & Snow, 2012) interventions to improve health outcomes. The findings in this study indicate that awareness of health practices and acting on the health information has the potential to decrease the occurrence of most

complications. For instance, engagement in heavy duty work is the main cause of many basic illnesses for women in rural areas and, if not managed, can lead to serious complications e.g. a miscarriage. The information received from MSSM prompted the women to reduce their workload and have more time to rest, and take on a nutritious diet that prevented ailments caused by deficiencies in the body.

Awareness of the benefits of prenatal services encouraged the women to attend ANC, including a routine health check-up for early detection of pregnancy risks. In addition, they could receive blood supplements and prophylaxis for malaria and vaccinations for tetanus, secondary health outcomes that impact maternal health outcomes (Lund et al., 2014a). MSSM services facilitated urgent care for emergency obstetric referrals in the sense that women were encouraged to seek medical attention immediately, without wasting time. The referrals were to some extent ineffective compared to other studies (Cole-Ceesay et al., 2010; Huq et al., 2012; Oyeyemi & Wynn, 2014), due to poor logistics in the health system and lack of coordination between the implementing agency, the local health facilities and the district hospital.

However, referrals minimised the delay in making a decision to go to a health facility, one of the main barriers in seeking medical care in maternal health (Noordam et al., 2011). Women would be advised on how to keep the situation under control before going to the clinic, since transportation was a problem. Consequently, serious complications would reach the health facility before progressing to a critical stage, thus reducing maternal deaths. An interesting finding for this study was that the woman, being the carer of a family, showed a change in her behaviour to seek medical care in time; this had effects on the whole family. In general there was an increase in people seeking care, as reported by all the health workers interviewed.

Information on baby development and childbirth is useful for women to plan and prepare for skilled attendance delivery; it encourages women to actually give birth at a health facility. The women were aware of their EDD and could prepare for the essentials required for health facilities for childbirth. One of the key findings of this study was that childbirth supervised by a trained health worker increased in the piloted area; just like in other studies

(Lund et al., 2014b; Oyeyemi & Wynn, 2014), this could not be attributed to MSSM intervention alone but it was evident that mHealth played a role.

8.2.3 Economic capabilities

The convenience of receiving medical care while at home was cost-effective for the women; they could save on financial resources and time (Huq et al., 2012; Tamrat & Kachnowski, 2012). The savings of transport costs and unnecessary medical costs enabled the women to meet other critical needs in their lives, being in a low-resourced environment. Further, the women had more time to engage in activities that would benefit them socially and financially. Thus, the convenience of mHealth services allows for the generation of socio-economic activities that expand opportunities for sustaining livelihoods (Sen, 1999).

8.2.4 Self-development capabilities

The analysis shows that the enhanced proficiency in the use of mobile phones had a positive effect on the women's self-esteem. This is consistent with the findings of Gigler (2011), where proficiency of ICT had a positive impact on psychological well-being, mostly for vulnerable groups such as women. Further, access to mHealth services enhanced self-confidence in the women and improved their individual agency. It also increased their self-reliance in maternal care. Agency and autonomy are intangible social benefits that can impact development outcomes i.e. improved health outcomes that reduces MMR (Gomez & Pather, 2012).

The culture of most developing countries limits women's participation in key decisions; even the decisions that affect their lives. By being informed health consumers, women can take responsibility and act as agents of their own health (Lund et al., 2012; Ruger, 2010). Informational capabilities are a source of individual empowerment, with positive effects on the women's self-esteem. Further, MSSM users were perceived to be modern and advanced, with enhanced social status in the community. The realisation of the effects observed was influenced by contextual dynamics in one way or another.

8.3 Contextual factors influencing mHealth outcomes in maternal health

From the study, it is evident that the extent to which consumers can achieve their capabilities and freedoms from mHealth services is not solely dependent on the intervention, but is mediated by contextual dynamics. This empirically substantiates the arguments of Sen (1993) that the relationship between capabilities and the achieved functionings is influenced by conversion factors.

8.3.1 Personal factors

The personal factors affecting mHealth outcomes in the maternal health range from mobile phone skills and competence, self-efficacy, literacy, to the age of a woman. The gender digital divide in developing countries is aggravated by discrepancies in employment, income, and literacy; resulting in women being 21% less likely to own a phone than men (Hilbert, 2011; ITU, 2010). This has a huge impact on women's ICT skills. Most of the women using MSSM did not have mobile phones; the majority using own phones borrowed from their husbands. Consequently, in the beginning, the women lacked skills to use MSSM effectively as in operating the phone and choosing the right options for the required service. Most of the women gained mobile phone skills after they started using the mHealth services. This substantiates that when given the opportunity, women can embrace digital technology enthusiastically (Hilbert, 2011).

Competency to comprehend and interpret the health information affects the effectiveness of mHealth services (Datta et al., 2014; Osborn, 2013). Superficial understanding was found to be exacerbated by low literacy. Women with slightly higher levels of education had no problems using the system and operationalising the health information. Correspondingly, the monitoring and evaluation reports showed that intention to change and actual behavioural change was much more evident among women who had a slightly higher level of education (especially those using text messages) than their counterparts. These findings are consistent with the findings of Crawford et al. (2014) in a study of a similar intervention in Malawi, where actual behavioural change was high in women using text messages. Such women understood and applied the messages in their situations with fewer impediments

e.g. they had better digital skills, access to mobile phone, and resources to put the health information into practice. Thus, despite creating opportunities for people in low resourced areas, ICT comes with rigidities such as perpetuating the divide among poor people; where the ones who are well-off tend to benefit more than the disadvantaged (Van Dijk, 2012).

Age of the woman can mediate access and use of mHealth services for maternal health. On the one hand, young women in the age range of 15 to 19 years were not using the intervention, as they usually got maternal care information from elderly women (Lori & Bolye, 2011; Seljeskog et al., 2007). On the other hand, middle-aged women (35 years and above) perceived themselves to have adequate knowledge regarding pregnancy and childbirth through experience. MSSM introduced a new system component for WCBA, providing reproductive health and family planning information in trying to capture these groups. Still more research and strategies are needed to identify and address factors which may alienate people of a certain age group from benefiting from an intervention.

8.3.2 Social factors

The major social factors that led to variation in health outcomes were role of intermediaries; traditional and religious beliefs; position of women in society; lack of resources; family support; poor quality of health services; and programme implementation challenges. The role of intermediaries is critical in ICT4D; it can be vital or destructive, depending on how it is integrated in the design and operations of an intervention (Sein & Furuholt, 2009). Community Volunteers were the key gateway to reach deep into the community and provide mobile phone access and usage in MSSM; they had great potential to make a positive impact, as they enabled healthcare to reach the digitally excluded in remote areas (Nyemba-Mudenda & Chigona, 2013). However, this study found that most of the Community Volunteers were rarely available for the women to use the phone; this was due to attrition for lack of reward in their job, among other reasons.

The analysis indicates that the gender of intermediaries can affect usage of mHealth services in maternal health. In rural areas, pregnancy is perceived as exclusively women's domain; putting men in a position where women are expected to talk about sensitive issues

can be a mismatch to the cultural norm of pregnancy. Initially women were uncomfortable talking to male HLWs, while some women could not use the community phone where the Community Volunteer was a man. In contrast, mothers developed good relationships with female Community Volunteers. The use of female intermediaries in mHealth interventions in maternal health encourages consumers' engagement; this was also evident in Nigeria and Zanzibar where the community health workers connecting mothers to the clinics were women (Lund et al., 2014b; Oyeyemi & Wynn, 2014).

Some socio-cultural beliefs relating to tradition and religion have adverse effects on the uptake and adoption of mHealth services. Knowledge of EDD, a novel idea to the women and communities at large, coupled with the use of a password as a unique identity number for retrieving messages, was perceived as satanism. This was due to lack of understanding of how the EDD was derived, religious beliefs, and traditional cultural practices, which instilled fear in many people and affected uptake and usage negatively. Technology resistance due to cultural beliefs is a challenge to ICT4D projects that use biometrics and numbers for identification in Africa, as they are regarded to be of satanic, relating to the mark of the beast 666 (Berger & Nakata, 2013; Donovan & Martin, 2014).

Religious convictions and cultural beliefs also constrained the women in implementing the health practices they had learned. These beliefs span from pregnancy being a private matter for fear of losing the baby due to witchcraft, to the use of traditional medicine, and rituals that are harmful in pregnancy and childbirth, similar to the finding of Lori and Boyle (2011), and Wilkinson and Callister (2010). These beliefs and values had great impact on a family's decision about the source of maternal care, despite the mother being enlightened from the use of mHealth services. Understanding of local culture is important in ICT4D initiatives, and addressing such beliefs may improve acceptance and adoption of mHealth and ICT services in general.

One of the main findings of this study is that family support is a critical factor for women empowerment in developing countries, and it impacts on mHealth outcomes in maternal health. Since women are not involved in most key decisions, it was found that most women's discretion to use MSSM or seek medical attention was dependent on the values of

a husband and elders in the family. Sharing information obtained from MSSM with husbands and family members responsible for decision making helped the women to gain support in using mHealth services and even applying the health practices. It is essential for mHealth interventions in maternal health to involve, and provide information to, these decision makers. Involving decision makers has proved to be effective in rural areas of Ghana and Bangladesh, where family support was enhanced (Huq et al., 2012; Osborn, 2013).

The position of women in societies in developing countries puts them at a disadvantage (Buskens & Webb, 2009; Hilbert, 2011). For instance, women in rural areas of developing countries have many more responsibilities compared to their partners (Bowie & Geubbels, 2013). The study noted that women are preoccupied with these responsibilities to the point of ignoring seeking medical care when need arises; some participants claimed to have been too busy to access MSSM services at times. In addition, the majority of women failed to achieve health outcomes due to lack of resources in applying the health practices. A desire to seek medical services or give birth at a health facility would be challenged by circumstances such as distance, fear of expenses e.g. transport money, financial resources to buy the essentials for childbirth at a health facility, and for food when admitted at a health facility. These findings are consistent with those described by Kasenga et al. (2010) and Seljeskog et al. (2007) in their analysis of impeding factors in seeking medical services in maternal health in Malawi.

Discrimination against HIV/AIDS positive mothers in communities strongly discouraged women from seeking prenatal services and giving birth at the clinic. Kasenga et al. (2010) had similar findings in Malawi where women suffered depression and anxiety and the majority did not disclose their status to their partners for fear of economic ruin and domestic violence. mHealth services in maternal health should also cover HIV/AIDS issues and strengthen involvement of those with authority over women, especially spouses.

8.3.3 Environmental factors

Similar to other developing countries, lack of resources and poor infrastructure in Malawi, including low mobile phone ownership in rural areas, poor network coverage, system outage, and lack of electricity, affected mHealth access. The provision of community mobile phones by the implementers increased accessibility and reach of the services, even to the digitally excluded. However, this model is expensive to be replicated and sustained for a large scale implementation. It would have been more realistic to pilot the intervention in closer touch with the local realities, where people use what they have, so as to increase chances of scalability and sustainability (Chan & Kaufman, 2010).

Limited access to electricity, as noted by several studies (e.g. Chigona et al., 2012; Little et al., 2013), is a big challenge in ICT4D interventions. Most phones were usually out of battery power or switched off due to limited charging resources. Poor network coverage contributed to most failing attempts to reach MSSM, affecting women's access to mHealth services in an adverse way. Long distance to health facilities, a poor transportation system, and lack of resources at health facilities restricted women from achieving health outcomes. Further, poor quality of services at health facilities, coupled with the negative attitude of health workers, discouraged some women from seeking maternal health services. These environmental factors are common in developing countries (Aranda-Jan et al., 2014; Noordam et al., 2011; Tamrat & Kachnowski, 2012)

8.4 The causes of mHealth outcomes for maternal health consumers

The causal mechanisms inherent in the structures that constituted the capabilities are the determinants of observed mHealth outcomes; and were mediated by the contextual factors, which either activated or inhibited their workings, resulting in varied outcomes for the women. The main finding of this study is that the pathway through which maternal health outcomes are produced for women in mHealth interventions starts with elements pertaining to technology adoption, to consumers acting on opportunities generated by mHealth as agents of their health, and finally the structural mechanisms of the health system. The attributes of mHealth expand the freedom or enhance the opportunities for

consumers in maternal health (Sen, 1999). The analysis confirms that the characteristics and affordances of the system as they permeate consumer's cognition, give them reasons to use the intervention. mHealth use may lead to empowerment and improved consumer agency, which facilitate the realisation of health goals. Further, health system organisation and infrastructure, in terms of resources and procedures for provision of adequate care, are critical to realising desired health outcomes.

8.4.1 Technology adoption mechanisms

Technology acceptance is a crucial precondition to technology adoption, and mHealth adoption is a necessary condition for mHealth use and realisation of health outcomes (Chib et al., 2014). The mechanisms relating to mHealth as a technology tend to be those that facilitate uptake and adoption. The case analysis shows that complexity, relative advantage, compatibility, and system affordance are the forces behind uptake and adoption of mHealth services in maternal health in rural areas of developing countries. In the case of MSSM, the complexity mechanism manifested in the form of simplicity of the mobile system and perceived ease of use. Design of system in terms of accessibility, user interface, and presentation of health messages affect users' perception of the system; when users perceive the system as easy to use, it is more likely that the uptake and adoption rates increase. Aranda-Jana et al. (2014) also found that relative ease of use and access to technology had a positive impact on the uptake of mHealth services.

Availability of mobile phones is a critical factor in mHealth interventions. Although the mobile phone ownership in rural areas of developing countries is low, especially among women, the culture of sharing enhances accessibility (James, 2011). Similarly, in MSSM, the establishment of volunteers in the communities in addition to free services enhanced MSSM access and use, and had a huge impact on perceived ease of use. Free services tend to increase uptake and adoption of mHealth in developing countries; this has been substantiated in other studies in maternal health both in Africa and Asia (Datta et al., 2014; Osborn, 2013). Nevertheless, the mediation of factors such as low levels of literacy, attitude towards the intervention, cultural beliefs, and poor telecommunication infrastructure, constrained some women from accessing the mHealth services, resulting in non-use.

The relative advantage of mHealth over other maternal care options lies in offering immediacy of health information and services because of the ubiquitous power of mobile technology (Akter et al., 2013). Women have the opportunity to access maternal health services and interact with health workers at any time right in their communities. This in turn saves women walking long distances to seek maternal health services, with the socio-economic implication of saving time and financial resources (Huq et al., 2012; Noordam et al., 2011). Women may gain confidence from the interaction with health workers on the phone and are empowered to be informed maternal health consumers, which increases patient engagement at a health facility.

The analysis also indicates that quality of information in meeting the needs of the women facilitates adoption. mHealth in maternal healthcare offers an alternative source of information; similar to findings of other studies (e.g. Osborn, 2013), women perceive educative mHealth services 'like having an aunt' who provides maternal health information. Several studies that have applied Diffusion of Innovation framework have consistently identified relative advantage as one of the most important determinants of technology acceptance (Corneille et al., 2014; Huq et al., 2012), showing that the decision to adopt technology is mostly driven by utilitarian motivations. This implies that for women to adopt mHealth services in maternal health, they must first be convinced that the information would resolve and improve their maternal issues.

Implementation of mHealth in maternal health needs to take into account non-harmful ideologies that enhance local appropriation of programmes and local support. The findings show that mHealth interventions in maternal health are more effectively implemented when congruent with socio-cultural conditions of the local reality. This is one of the critical success factors of eHealth and mHealth programmes in developing countries, as it increases programme acceptance and adoption (Chan & Kaufman, 2010). Perceived privacy and confidentiality enhance the effectiveness of mHealth in maternal healthcare, and may increase uptake and adoption.

However, MSSM was not aligned with some critical dynamics in the context of MSSM, such as gender sensitivity of the maternal care domain, traditional maternal care systems, and

incentives for programme participants, which affected adoption of the services in an adverse way. Elderly women as custodians of traditional maternal care systems were not involved in MSSM, which brought resistance, because they perceived the intervention as a threat to their culture. Exclusion of traditional maternal care systems by mHealth intervention in maternal health may be viewed as a challenge to the information brokerage role of existing community organisations and results in lack of local support (Gigler, 2011). Failure to meet community stakeholders' expectations, especially that of incentives, usually decreases adoption of mHealth and leads to attrition, resulting in minimal community involvement. Studies have shown that mHealth intervention without a reward programme risks the buy-in of community stakeholders (Little et al., 2013; Vélez et al., 2014), and this affects the operation of the project.

Timely, reliable, and actionable information from mHealth interventions increases adoption of health practices that improve health outcomes in maternal health. The health practices through 'tips and reminders' changed the women's worldview and impacted on their way of doing things. The transformative learning affordance was MSSM's intrinsic instrumental means of empowering the women with health information, which helped them to do things outside their normal sphere of ethos, such as being secure in their pregnancy and having the support of their husbands in maternal issues. Factors like education level affected the way a woman comprehended and interpreted the health messages and advices for their condition. This is the case in many developing countries, due to women having low literacy (Lund et al., 2014a; Pundir et al., 2012).

8.4.2 Activation of health information

IT resources are necessary but not sufficient to make a difference in human capabilities, an individual needs to leverage the opportunities offered by ICT to enhance human capabilities through meaningful use and acting on the information. Self-efficacy, choice, and acting on opportunities regulate agency in the process of empowerment. Self-efficacy manifested in two ways in the case of MSSM – perceived technology self-efficacy, and a perceived operative capability in health behaviour change (Schwarzer & Fuchs, 1996). Similar to the findings of Lim et al. (2011), in a study of Singaporean women using mobile phones to seek

health information, this study found that women with highly perceived technology self-efficacy are more likely to use mHealth services in maternal healthcare. The study showed that knowledge from mHealth services may enhance self-efficacy of the women by increasing the confidence to embrace maternal health practices and improve health outcomes. A belief that a particular behaviour can result in a desirable maternal health outcome may increase perceived self-efficacy of a woman for that specific behaviour, resulting in health practices' adoption and adherence (Schwarzer & Fuchs, 1996).

Choice of activities and action taken by a woman as a consumer of maternal health are the main drivers in the process of moving from potential functionings to achieved functionings (Kleine, 2013). Activation of health information is determined by the choice of activities that women choose to engage in. Acting on the opportunities in one's capability set generated by mHealth intervention tends to increase the likelihood of achieving one's health goals and improving health outcomes. The analysis showed that women weighed the opportunities generated from MSSM against other maternal care options. Their choice of activities was greatly influenced by their perceived operative capability, which was significantly mediated by family support, due to financial implications attached to it and lack of autonomy in women in developing countries. The choice of activities led to varied actions, some yielding improved health outcomes while others not. This implies that knowledge does not necessarily result in practice. Women in this study knew what to do, but because of their circumstances, it was difficult for some to put the knowledge into practice. Finally, women would evaluate the consequences of their actions to gauge the effectiveness of the intervention in their situation. This has a huge impact on continual use of mHealth services and adherence to health practices.

8.4.3 Health system drivers

Harmonisation between the health system and mHealth implementers can improve efficiencies for the provision of maternal healthcare (Aranda-Jan et al., 2014; Tamrat & Kachnowski, 2012). This was not the case in MSSM; poor coordination between MSSM implementers and the health system, especially at community health facility level, and lack of complementary maternal healthcare resources, affected the operations and performance

of the programme adversely, decreasing its effectiveness. The women were discouraged by the poor service, which was exacerbated by poor conditions of the health system in general. While ICT can help enhance women's access to health information and services, they cannot meaningfully alter existing health system structures and the poor conditions of health facilities in developing countries. This is evident in many studies on the use of technology in health (Chib et al., 2014; Noordam et al., 2011; Tamrat & Kachnowski, 2012). The poor health structures and conditions inhibit the effectiveness of technology such as mHealth in improving health outcomes.

Poor access to health information is only one among many factors (e.g. shortage of staff) that have led to poor maternal health outcomes in developing countries (Hogan et al., 2010; Oyeyemi & Wynn, 2014). Therefore, improving access to health information is not, by itself, sufficient to significantly reduce maternal morbidity and mortality in developing countries. Studies in mHealth and Information and Communication Technology for Health (ICT4H) in general have shown that the use of ICT can improve access to health information, data management, and service delivery (DeRenzi et al., 2011; Free et al., 2013); but it does not improve the poor conditions of health systems in developing countries that are in dire need of refurbishment. Oyeyemi and Wynn (2014) found that improving services at health facilities and pregnant women's access to free mobile phone services have great potential to increase utilisation of the primary healthcare system. With the poor conditions of health systems in developing countries, mHealth, just like other ICT, fails to reflect any significant positive impact on health outcomes, especially when health indicators are used. The health consumers perceive mHealth programmes and the health system as one entity. Therefore failures in the health systems render mHealth services to be less meaningful to maternal health consumers. Consequently, health system failures may affect the confidence and trust of women in mHealth services.

Communication on referrals has proved to save time with critical conditions; involvement of health personnel at all levels, and integration of the mobile system into existing health system can facilitate this and other processes in healthcare (Huq et al., 2012; Little et al., 2013). Coordination between implementing agencies and health facilities can create a network for effective sharing of information on resources availability and optimal facilities

to send clients without wasting time. MSSM lacked inter-organisational coordination that resulted in government and health workers' minimal involvement in the project. This affected the programme operations and reduced effectiveness, and had implications on sustainability and scalability. Studies have shown that achieving a strong sense of ownership and empowerment among health workers is a prerequisite for a successful introduction of any mHealth programme (Little et al., 2013; Ngabo et al., 2012).

8.5 Summary of the chapter

The thesis examined how mHealth interventions contribute to outcomes in maternal health for consumers in a developing world context. The study analysed how mHealth outcomes are produced and how variations in outcomes can be explained, using critical realism and capability approach. The findings show that the use of mobile phones in maternal health generates numerous opportunities for women as consumers, not only to achieve health outcomes, but also for social change in other aspects of life that lead to human development. The opportunities generated for the women were mainly caused by attributes and affordance of the mHealth system as a technology innovation. The process of realising desired outcomes involved individual agency, where women exercised their freedom to choose activities that would result in a life or state they have reason to value. Further, health system structures and system integration are critical for realisation of positive maternal health outcomes. The processes involved in the pathway from generating capabilities to actualisation of outcomes are mediated by personal, socio-cultural, and environmental factors, resulting in variation of outcomes among women. Table 8-1 presents a detailed summary of the discussion.

Table 8-1: A summary of how mHealth outcomes for maternal health consumers in a developing country context are produced

Commodities	Potential Capabilities	Conversion factors	Causal Mechanisms
<p>MSSM intervention</p> <ul style="list-style-type: none"> - Hotline - Tips and reminders - Community mobilisation using Community Volunteers 	<p>Informational capabilities</p> <p>IT literacy</p> <ul style="list-style-type: none"> - To gain mobile phone knowledge <p>Maternal health information</p> <ul style="list-style-type: none"> - To receive timely, reliable and practical health information - To have an alternative source of maternal care information <p>Empowerment</p> <ul style="list-style-type: none"> - To be informed maternal health consumers - To share health information with others - To be engaged as patients - To feel secure about their pregnancy <p>To communicate</p> <ul style="list-style-type: none"> - Communicate openly about maternal issues - Engage with health workers <p>Health capabilities</p> <ul style="list-style-type: none"> - To adopt home-based and facility –based health practices - To seek healthcare services in good time - To plan and prepare for childbirth - To give birth at a health facility - To have postnatal check-up - To have health pregnancy and healthy baby <p>Economic capabilities</p> <ul style="list-style-type: none"> - To save financial resources - To save time <p>Self-development capabilities</p> <ul style="list-style-type: none"> - To be self-confident and self-reliant in maternal healthcare - To feel comfortable using mobile phones - To be expressive - To be modern – being part of the civilised world 	<p>Personal factors</p> <p>Lack of technology skills</p> <p>Low literacy</p> <p>Low income status</p> <p>Marital status</p> <p>Social factors</p> <p>Low position of women in society</p> <ul style="list-style-type: none"> - Low mobile phone ownership - Having too many responsibilities, not prioritising healthcare <p>Role of Community Volunteer</p> <ul style="list-style-type: none"> - Availability of Community Volunteers - Gender and age of a Community Volunteer - Commitment <p>Family support</p> <p>Cultural beliefs</p> <ul style="list-style-type: none"> - Secrecy surrounding pregnancy - Beliefs of witchcraft - Traditional and religious beliefs - Influence of elderly women - Belief that intervention was a satanic gimmick <p>Marital problems – Polygamy and men leaving for greener pastures</p> <p>Economic</p> <ul style="list-style-type: none"> - Free services - High costs of telecommunication on the part of the implementers <p>Health facility</p> <ul style="list-style-type: none"> - Attitude of health workers - HIV/AIDS testing at ANC <p>Lack of participants’ incentives</p> <p>Environmental factors</p> <p>Lack of resources (poverty)</p> <p>Availability of phone</p> <p>Non-durable community phones</p> <p>Infrastructure</p> <ul style="list-style-type: none"> - Limited electricity coverage - Poor mobile phone network coverage - System outage - Poor transportation system <p>Long distance to health facilities</p> <p>Poor conditions of health facilities</p>	<p>Technology adoption mechanisms</p> <p>Complexity</p> <ul style="list-style-type: none"> - Simplicity-in-design of system - Perceived ease of use <p>Relative advantage</p> <ul style="list-style-type: none"> - Immediacy of health services - Saving time and financial resources - Meaningful interaction with health workers - Quality maternal health information - Quality of services - Perceived confidentiality <p>Compatibility</p> <ul style="list-style-type: none"> - Perceived privacy - Gender sensitivity - Expectations of incentives - Exclusion of traditional maternal care system <p>System affordance</p> <ul style="list-style-type: none"> - Learning home-based and facility-based health practices <p>Agential mechanisms</p> <p>Self-efficacy</p> <ul style="list-style-type: none"> - Technology self-efficacy - Health behavioural change self-efficacy <p>Choice of activities</p> <p>Acting on health information</p> <p>Organisation mechanism</p> <p>Lack of complementary resources at health facility</p> <p>Lack of system integration</p> <ul style="list-style-type: none"> - Minimal involvement of the health workers and government in general - Lack of inter-organisation coordination

9 CONCLUSION

9.1 Introduction

This thesis is concerned with how mHealth outcomes for maternal healthcare consumers are produced in developing countries at the micro level of rural communities. Drawing on the findings, Chapter 8 discussed some theoretical implications of mHealth use in maternal health. This chapter provides an overview of the research, research contributions, study limitations, suggestions for future research, and personal reflections.

9.2 Overview of the research

The research question for this study was *“How are maternal health outcomes achieved through the use of mobile phones by women in developing countries?”* This has been evaluated by studying the capability outcomes for the women using MSSM, and the necessary conditions inherent in the structures of the capabilities responsible for the generation of the opportunities. mHealth and human capabilities have a link, which is mediated by personal and situational mechanisms that guide the empowerment process to realisation of health outcomes. This research has demonstrated the pathway from mobile technology use by health consumers to the realisation of health outcomes using CA as an explanatory theory, in cooperation with other theories that fit in with CA tenets and complement its explanatory power in highlighting the causal mechanisms. The findings in this study have shown that the mechanisms producing outcomes in mHealth for maternal health consumers emanate from structures pertaining to technology adoption, agency, the health system, and programme management.

Just like any technology innovation, the pathway of mHealth starts with technology access and use, acceptance and adoption by the consumers, which is best explained by the theory of Diffusion of Innovation (Rogers, 1995; 2010). Low complexity, relative advantage, and compatibility drive the uptake and adoption of mHealth in rural areas of developing countries. The study found that simplicity of a mobile system and free mHealth services enhance perceived ease of use, which tends to increase mHealth adoption among consumers. The

relative advantage of mHealth lies in the convenience of services compared to other maternal care options. Maternal health consumers perceive immediacy of mHealth services, financial resources and time savings, interaction with health personnel, quality of information and services as useful; this encourages them to use the mHealth services to solve maternal health problems.

The study has shown that the significance of compatibility should not be undermined, as this can hugely affect both the adoption of mHealth as a technology and the realisation of the desired health outcomes. mHealth interventions should be designed in such a way that they meet the needs of the consumers and are accustomed to the values and beliefs of local communities. In addition, non-harmful socio-cultural ideologies relating to pregnancy care and traditional information systems can be incorporated into mHealth intervention in maternal health. This helps to gain trust and support of the local people, which contributes to programme success. Further timely, reliable and practical information from mHealth interventions tends to increase adoption of home-based and facility-based health practices; this enhances consumer empowerment and patient engagement.

Empowerment through enhanced informational capabilities has a positive effect on individual agency of a woman in making strategic choices about maternal health, then translating these choices into desired health outcomes. This process was found to be regulated by three agential mechanisms of self-efficacy, choice, and acting on the health information. The findings indicate that self-efficacy mediates the choice of activities that women engage in to achieve health goals in maternal healthcare, and a high degree of self-efficacy tends to increase the likelihood of a woman choosing to enact on opportunities enabled by mHealth interventions to achieve health goals. While an action taken is determined by the choice of activities that women choose to engage in, acting on the opportunities in one's capability set generated by mHealth intervention tends to increase the likelihood of achieving one's health goals and improving health outcomes.

In the case of MSSM, the health system and programme management drivers manifested in the form of lack of system integration and lack of complementary maternal health resources at health facilities. Lack of resources and poor infrastructure at health facilities result in poor quality of maternal healthcare services for the women. This tends to reduce the effectiveness of mHealth intervention in improving health outcomes, and affects the uptake and continual use of mHealth services. Lack of inter-organisational collaboration among the implementing agency, local health facilities and the district hospital, and failure to incorporate mHealth into the existing health system, had adverse effects on the programmes' outcomes and effectiveness. System integration, if designed and implemented properly through collaboration with all key stakeholders, may enhance efficiencies in the health system and improve access to health information and services that can improve health outcomes in maternal health.

The opportunities that were generated from mHealth use for maternal health consumers went beyond health capabilities and included informational capabilities, economic capabilities and self-development capabilities. The use of mobile phones to access maternal health information and services has potential to: enhance the mobile phone skills for women in developing countries; increase learning benefits for the women and improve their information capital in maternal health and health in general; enhance communication skills with health workers and in the community; in addition to saving the women time and financial resources; and can be a source of individual and patient empowerment, resulting in patient engagement.

The study shows that the opportunities or benefits from mHealth use have potential to improve the abilities and health of maternal health consumers. However, the effects that the intervention had on the pregnant mothers as individuals were diverse. Some women achieved positive outcomes while many others had difficulties in benefitting from the full potential of the increase in opportunities. This was due to intermediation of several conversion factors that inhibited or activated the causal mechanisms, resulting in varied outcomes. For instance:

- a. Low availability of mobile phones in a village affected ease of access and use, and had an adverse effect on many women's ability to use the mHealth services.

- b. Lack of support structures in the programme meant that many villages were unable to get their mobile phones repaired, which affected mHealth use.
- c. Lack of family support and poor economic status of the pregnant mothers also restricted their abilities to choose to act on the opportunities enabled for them.
- d. Poor conditions of the health system further restricted some women from getting adequate care from the health facilities, despite using the mHealth services.

Multiple factors of a personal, social, and environmental nature affected the process of mHealth use to realise health outcomes.

9.3 Contributions of the study

The study makes three types of contribution; to theory, methodology, and practice.

9.3.1 Contributions to theory

The study makes a contribution to theory in three ways; the use of CA as an explanatory theory of mHealth in maternal health; incorporation of different theories in CA to enhance its explanatory power; and the body of knowledge on mHealth in ICT4D research.

Despite CA gaining popularity in ICT4D research in the last decade, its use to analyse the contribution of ICT to human development is still in its infancy. Further, a few studies have used CA as an analytical evaluative tool in ICT4H. These studies have focused on health information systems implementation (Madon, Sahay, & Sudan, 2007), and ICT use by health workers (Zheng & Walsham, 2008). To the researcher's knowledge, this study is the first to use CA as an explanatory theory in the domain of mHealth. The interpretation of CA in this study may be seen as a theoretical contribution to the ICT4D field as it can be used to further the understanding of the underlying mechanisms on the pathway from ICT use to development outcomes from the consumers' perspective. The conversion factors in CA entail contextual causality (Smith & Seward, 2009), and most of the studies that have applied CA in ICT4D have used the conversions factors as causes for the observed outcomes. This study went a step

further and highlighted the underlying mechanisms that link capabilities and their associated mHealth outcomes for maternal health consumers, and how these are mediated by conversion factors.

The study has also shown that CA is capable of explaining the entire pathway from ICT use to development outcomes in a complex multidisciplinary field of mHealth and ICT4D in general (Chib et al., 2014; Heeks, 2008). Since CA operates at a scientific ontology level, and is considered not to be a substantive theory but an under-labouring exercise for science (Martins, 2006; 2007a; 2007b), it describes entities at an abstract level such as commodities in general, and not ICT specifically. Therefore, the study brought in other theories that could best explain all the processes from mHealth use to realised health outcomes within the CA framework. Diffusion of Innovation theory (Rogers, 1995; 2010) and ICT affordances theory (Conole & Dyke, 2004) were used to explain the characteristics of mHealth technology as a commodity; and the explanation on the utilisation of opportunities by consumers as agents of their own health was augmented by theories of choice, rational choice, and empowerment (Cattaneo & Chapman, 2010; Kleine, 2010; Paternoster & Pogarsky, 2009). In this way the study addressed the limitations of CA in being vague and abstract to scientifically explain ICT adoption factors that lead to development outcomes. Thus, this contributes to the IS field another approach to using CA and expanding the scope of theoretical analysis of contemporary ICT4D studies.

The empirical evidence and theory (Chapters 5, 6 & 7) in this thesis contributes to the body of knowledge on mHealth evaluation and effectiveness in developing countries. The research has answered a multifaceted question of how mHealth outcomes are produced for maternal health consumers in the developing country context of Malawi. The study connects maternal health to human development (UNDP, 2010), and analysed how mobile phones can enhance human capabilities for women to live a life they value in pregnancy and childbirth. The study reveals that mobile phone use generates four categories of capabilities for maternal health consumers; informational, health, economic, and self-development. It further substantiates that there is no direct link between ICT and development outcomes, mobile phone use and health outcomes in

this case. ICT, like mHealth, increases the information capital and connectedness of the consumers (Gigler, 2011; Smith et al., 2011); this enables them to make strategic choices and translate these choices into desired outcomes. The process of empowerment through enhanced informational capabilities resulting in informed health consumers, is what links mHealth to health outcomes as development effects.

To elucidate the pathway through which mHealth outcomes are produced for consumers in maternal health, the study reveals a nexus of mechanisms in the process of empowerment from mobile phone use to actualised health outcomes. These mechanisms ranged from technology adoption and agential factors, to health system drivers. Studies that have operationalised CA in ICT4D have mainly focused on how the characteristics of ICT (i.e. system features) generate opportunities for consumers (Grunfeld et al., 2011; Hatakka et al., 2014; Kleine, 2013). This study has gone further by highlighting how attributes and affordances of technology permeate the cognition of users and give them reasons for technology uptake and adoption. Individual agency is necessary in making choices to translate the opportunities into desired outcomes or intervention outcomes (Kleine, 2010; Robeyns, 2006). However, the realisation of health outcomes is largely influenced by health system infrastructure and procedures in developing countries, which usually downplay the effectiveness of mHealth interventions. The entire pathway from technology adoption to health outcomes is subjected to contextual dynamics of open systems; the personal, social and environmental conversion factors that either trigger or inhibit the mechanisms resulting in different outcomes for the consumers. This research has contributed to the knowledge base by identifying and refining some middle range theories of *'HOW, WHY and IN WHAT CIRCUMSTANCES'* questions about mHealth outcomes for maternal health consumers that bring out intangible social effects rather than just relying on health indicators or outcomes.

9.3.2 Contributions to methodology

Studies have claimed that using CA from the critical realist perspective strengthens its explanatory power and addresses the common criticism of theory-data gap (McGrath, 2013;

Smith & Seward, 2005; 2009). This research is probably the first to apply CA using the critical realism ontology with its epistemic relativity in ICT4D research, and mHealth in particular. The study has shown how the two approaches are complementary and mutually enriching, as asserted by Martins (2007b; 2006). The conceptualisation of capabilities constituting structures with powers allows for a deeper analysis of the underlying mechanisms that explain why and how outcomes are realised, or not. For instance, choice of a woman explains why some women still give birth at home when they know the benefits of health facility delivery. Further, the conversion factors enrich the explanation by showing how contextual factors mediate the mechanisms i.e. family support as a social factor mediates the choice of a woman to seek medical care. The study also used a qualitative intensive case study, engaging in retrodution process that excavate and abstract mechanisms in a dyadic movement between theory and empirical evidence; an innovative and creative method of investigating underlying causes.

9.3.3 Contributions to practice

The study has demonstrated that CA provides a deeper perspective of the impact of mHealth as opposed to health indicators in maternal health. mHealth interventions in rural areas of developing countries have potential to contribute to human development in many other ways than just health. Even though the main purpose of mHealth interventions is to improve health, this study has shown that it has potential to enhance ICT skills, communication skills, and information capital of health consumers. Women's exposure to ICT, even with the widespread use of mobile phones, is limited due to low ownership and cultural factors. Thus, mHealth programmes need to devise strategies that can enhance ICT skills of key participants, i.e. training for the women and local health workers for effective results (Datta et al., 2014; Munro et al., 2014). The study has also shown that free mHealth services have economic benefits of saving time and financial resources – which is very valuable among people in limited resource settings – and need to be considered by donors and implementing agencies (Huq et al., 2012; Tamrat & Kachnowski, 2012).

A number of studies have claimed that there is a direct link between mobile technologies and health outcomes but evidence has been superficial, not convincing to policy makers (Aranda-Jan et al., 2014; Little et al., 2013; Mechael et al., 2010). This study has demonstrated that just as with all other information technologies, informational capabilities connect mobile phone use to health outcomes of consumers. Women become informed patients when they gain knowledge in maternal health; this facilitates patient empowerment and engagement that can lead to improved health outcomes. The pathway in mHealth starts with mechanisms for technology acceptance and uptake, individual agency, to health system drivers. Low complexity, perceived ease of use, and relative advantage of the mHealth system tend to increase adoption of mHealth services. The study has also shown that aligning mHealth intervention to local realities increases perceived relative advantage and consequently adoption. These mechanisms need to be incorporated in the planning and designing of mHealth programmes, together with systems affordance so as to increase adoption rate in the diffusion of this mHealth innovation.

Further, mHealth programmes should focus on all key stakeholders with the purpose of increasing their information capital for effectiveness of the intervention. Involvement and inclusion of other key stakeholders such as partners or those in authority over a woman's well-being improves family support and other enabling factors in facilitating agency of a woman; consequently, increasing mHealth adoption and the adoption and adherence of home-based and facility-based practices. It is also clear from this study that integration of mHealth interventions into existing health systems can eliminate some challenges that impede the effectiveness of mHealth, and in this way some factors that retrogressively affect mHealth cannot be overlooked e.g. poor conditions of health facilities. In general, mHealth success relies on technology adoption process, individual empowerment process, and the health system organisation.

The study has demonstrated that personal and time-specific information are more effective than public information. Consumers find personal and time-specific information easy to understand and consequently put into action. Furthermore, most developing countries

especially in Africa have an oral culture, thus a telephone conversation is most preferred, followed by voice messages, and then text messages for health behavioural change (Crawford et al., 2014; Oyeyemi & Wynn, 2014). These findings, if incorporated in the policy, plan, and design of mHealth programmes, have potential to enhance effectiveness in improving health outcomes.

9.4 Limitations of the study

Being a PhD thesis, the research process had time limitations. Even though the data used in the thesis was collected from June 2012 to March 2014, the main study informing the result was cross-sectional and conducted from September 2012 to December 2012. As such, the results of this study are more of identifying the mechanisms that produce the outcomes, and how they manifested in the case of MSSM. The use of CA and critical realism to explain the underlying mechanisms producing mHealth outcomes for maternal health consumers entail causality, which requires more time and a series of empirical investigations to validate the mechanisms and eliminate those with less explanatory power (McGrath, 2013; Zachariadis et al., 2013). The study conducted only one empirical investigation to substantiate the mechanisms identified; consequently the study did not draw out the context, mechanisms, and outcomes patterns that can show multiple causal paths to the same outcome as in other realist studies due to time constraints.

The researcher's academic background is computer science and information systems. Since this study attempted to show the entire pathway from technology use to realised health outcomes that involve other diverse disciplines of sociology, development, and health, she would like to acknowledge that many other mechanisms can contribute to the outcomes than just what is mentioned in this thesis. In the same vein, the study used one intensive case study to understand and substantiate these underlying mechanisms, which can narrow the view of the researcher. In an ideal situation, this kind of study requires several empirical investigations within the same case, or even more; using multiple other cases for comparison of the findings

(McGrath, 2013; Pawson & Manzano-Santaella, 2012). Comparing findings from multiple cases may add more value, a broader and deeper understanding of the mechanisms.

The study being underpinned by critical realism, the context of maternal healthcare in rural Malawi had a strong influence on the research findings. In this respect, the outcomes of this research may not necessarily apply to other mHealth interventions in Malawi or elsewhere. However, despite the aforementioned limitations to the study, the experiences of mHealth in maternal health in other studies from developing countries suggest that pregnant mothers there may have experienced similar events. As such, the findings from this research can be used by practitioners, policy-makers, and researchers as a starting point for further studies.

9.5 Possible future research direction

The limitations elaborated in the previous section form a basis for possible future research by both academics and practitioners. There are three future work suggestions that may emanate from this research. Since this study has simply identified the mechanisms of mHealth effects in maternal health in one case, future studies could use multiple case studies for a comparative analysis of the explanatory power of these mechanisms, and maybe identify more. On the same note, the use of mixed methods may enhance the explanations of causality between mechanisms and outcomes, and produce quantifiable impact measures of these determinants as evidence.

The complexity of linking mobile technology use to health outcomes emphasises the necessity of research that disentangles the mechanisms by which mHealth outcomes are produced in maternal health and also other domains, in relation to context. Current research designs and evaluation methods used in mHealth are inadequate for this purpose. Future studies could use functionings as an evaluative space in CA, coupled with critical realism methodologies, or could use Realist Evaluation model, and go beyond identifying mechanisms to demonstrate the patterns or configurations of context, mechanisms, and outcomes, to explain multiple causal paths to observed mHealth outcomes for consumers.

This study has investigated how the outcomes of mHealth are produced in maternal health from the consumers' perspective. Future studies could also explore the generative mechanisms of mHealth outcomes in healthcare service delivery from the health system perspective, in maternal health or indeed just healthcare in general.

9.6 Personal reflections

Personal reflections enabled me as a researcher to locate myself in the study endeavour. The reflections allowed me to critically analyse the choices and decisions made in carrying out the research inquiry, and address how these coupled with my actions influenced the outcome of the research process (Ortlipp, 2008; Sword, 1999). Undertaking this research has been an important and rewarding journey for me as an academic and individual. During the course of this research I constantly put into question my own views of ICT4D practice, as I reflected on the socio-cultural context within which technologies are embedded, especially in a sensitive domain as maternal health. In addition, as a woman in the child-bearing age group, my perceptions of motherhood, pregnancy, childbirth, and maternal health have been continually challenged.

At the onset of this research, the intention was to understand the effects of mobile technology use in healthcare, as all literature at that time pointed that mHealth has potential to improve health outcomes, but did not provide sufficient empirical evidence. I thought if the effectiveness of mHealth could not be established with substantial evidence; there might be some hindrances somewhere. This assumption brought me to my current objective to investigate the process through which mHealth outcomes are produced for maternal health consumers. Maternal health was chosen since it is one of the MDGs unlikely to be achieved by the 2015 target (Hogan et al., 2010), and as a researcher I have had an inclination toward maternal health phenomenon since my undergraduate studies. One of the principal driving forces pushing me through all the stages of the studies was an aspiration to have a positive impact on the lives of women and future practices of maternal health in rural Malawi through the use of ICT. Since I am from Malawi, it was an advantage to work with some of the

participants in my own language, which enabled me to fully engage myself and the participants in the research process. Being a mother myself and pregnant during the time of data collection, at times witnessing and listening to the experiences of these rural women in maternal health was stressful and disturbing; it was difficult to fully detach myself from the study.

The research design of critical realism normally starts with an empirical observation to understand the phenomenon, and then find theories that best explain it. Before embarking on the exploratory study I had already read on Capability Approach as an evaluative framework for development, and how it is compatible with the assumptions of critical realism, and its ability to bring out the causal mechanism. Seeing that no research had used CA in this way in any ICT4D research, I had keen interest to put the explanatory power of the framework to test. Thus, even during the initial study, I had CA at the back of my mind as a sensitising tool/framework (Seidel & Urquhart, 2013). Maybe the findings could have been different if I had not gone along with these preconceptions. The use of critical realism and CA created room to employ other theories in highlighting the causal processes that link mobile phone use to health outcomes in a way that might not have been easy (or even possible) if using other approaches.

A number of opportunities are enabled for women through mHealth, but realisation of such opportunities into desired outcomes is hindered by a myriad of contextual dynamics in rural areas of Malawi. Even with free mHealth services offered, the position of women in societies of developing countries makes it improbable for them to use the services. I observed that the techno-centric stance of implementing agencies can render mHealth services to be ineffective. Technologies do not work autonomously, but are woven into the lives of people. At the beginning the implementing agency simply pushed the mHealth services into the community with no marketing or follow-up strategy and it affected adoption negatively; it was when they connected with the communities, addressing some of the socio-cultural issues, that adoption increased. Multiple factors should be considered in the design and implementation of activities surrounding mHealth in maternal health to ensure provision of actionable, cost effective, and

quality health services. Further, mHealth interventions should incorporate strategies that can address factors influencing disparities in the lives of women.

My personal view is that negligible improvement in health outcomes does not necessarily mean that mHealth is ineffective or that consumers are not using mHealth services in developing countries; rather, I believe that the poor conditions of health facilities exacerbated by impoverished health systems are the dominant impeding factors to realisation of positive health outcomes. This consequently impacts on the effectiveness of mHealth if measured using health indicators. In addition, most mHealth programmes work in silo from the health systems, this lack of connection and coordination make it difficult and impossible (1) to attribute mHealth as a cause of health outcomes, and (2) to evaluate impact using health indicators.

Finally, just like other multidisciplinary fields, it is a challenge conducting a research in mHealth as it involves theories from different arenas. Researchers and practitioners in Computer Science, Information Systems, Social Sciences, and Health Sciences, as advocated by Chib et al. (2014), need to come together in collaboration to pave a way forward for the field.

10 REFERENCES

- Abimbola, S. (2011). Health systems in an interconnected world: A view from Nigeria. *MEDICC Review*, 13(3), 43-45.
- Abraham, K. B. (2009). The names in your address book: Are mobile phone networks effective in advocating women's rights in Zambia? In I. Buskens, & A. Webb (Eds.), *African women and ICTs: Investigating technology, gender and empowerment* (pp. 97-106). London: Zed Books.
- Adam, T., Lim, S., Mehta, S., Bhutta, Z., Fogstad, H., Mathai, M., ..., Darmstadt, G. (2005). Cost effectiveness analysis of strategies for maternal and neonatal health in developing countries. *British Medical Journal*, 331(7525), 1107.
- Agarwal, R. (2000). Individual acceptance of information technologies. *Framing the domains of IT management: Projecting the future through the past* (pp. 85-104). Cincinnati: Pinnaflex Education Resources.
- Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *The Journal of Economic Perspectives*, 24(3), 207-232.
- Akter, S., D'Ambra, J., & Ray, P. (2013). Development and validation of an instrument to measure user perceived service quality of mHealth. *Information & Management*, 50(4), 181-195.
- Alampay, E. (2006a). Analysing socio-demographic differences in the access use of ICTs in the Philippines using the capability approach. *The Electronic Journal on Information Systems in Developing Countries*, 27(5), 1-39.
- Alampay, E. (2006b). Beyond access to ICTs: Measuring capabilities in the information society. *International Journal of Education and Development using ICT*, 2(3), 4-22.
- Alkire, S. (2002a). Dimensions of human development. *World Development*, 30(2), 181-205.
- Alkire, S. (2002b). *Valuing freedoms: Sen's capability approach and poverty reduction*. New York: Oxford University Press.
- Alkire, S. (2008). Using capability approach: Evaluative and prospective analyses. In F. Comim, M. Qizilbash & S. Alkire (Eds.), *The capability approach: Concepts, measures and applications* (pp. 26-51). Cambridge: Cambridge University Press.
- Alsop, R., & Heinsohn, N. (2005). *Measuring empowerment in practice: Structuring analysis and framing indicators*. Washington DC: World Bank.

- Andreatta, P., Debpuur, D., Danquah, A., & Perosky, J. (2011). Using cell phones to collect postpartum hemorrhage outcome data in rural Ghana. *International Journal of Gynecology & Obstetrics*, 113(2), 148-151.
- Aranda-Jan, C. B., Mohutsiwa-Dibe, N., & Loukanova, S. (2014). Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa. *BMC Public Health*, 14(1), 188.
- Archer, M. (1995). *Realist social theory: The morphogenetic approach*. Cambridge University Press.
- Archer, M. S. (1998). Introduction: Realism in the social sciences. In M. S. Archer, R. Bhaskar, A. Collier, T. Lawson & A. Norrie (Eds.), *Critical realism: Essential readings* (pp. 189-205). Routledge.
- Ashar, R., Lewis, S., Blazes, D. L., & Chretien, J. P. (2010). Applying information and communications technologies to collect health data from remote settings: A systematic assessment of current technologies. *Journal of Biomedical Informatics*, 43(2), 332-341.
- Aubel, J., Touré, I., & Diagne, M. (2004). Senegalese grandmothers promote improved maternal and child nutrition practices: The guardians of tradition are not averse to change. *Social Science & Medicine*, 59(5), 945-959.
- Avgerou, C. (2008). Information systems in developing countries: A critical research review. *Journal of Information Technology*, 23(3), 133-146.
- Banda, C., & Chikumba, P. A. (2014). Stakeholder analysis and sustainability of telecenter projects in rural Malawi. *e-Infrastructure and e-services for developing countries* (pp. 188-197). Springer International Publishing.
- Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology*, 4(3), 359-373.
- Bandura, A., & Adams, N. E. (1977). Analysis of self-efficacy theory of behavioral change. *Cognitive Therapy and Research*, 1(4), 287-310.
- Banerjee, I., & Hsi-Shi Leong, C. (2006). Internet in the war against HIV/AIDS in Asia. *The Internet and health care: Theory, research and practice*, 357-373.
- Batra, S., Ahuja, S., Sinha, A., & Gordon, N. (2012). eCompliance: Enhancing tuberculosis treatment with biometric and mobile technology. *Proceedings of the 3rd Mobile for Development (M4D) Conference, New Delhi, India*. 28-29 February, 2012.36-40.

- Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly*, 11(3), 369-386.
- Bennett, A., & Elman, C. (2006). Qualitative research: Recent developments in case study methods. *Annual Review of Political Science*, 9, 455-476.
- Berger, E., & Nakata, C. (2013). Implementing technologies for financial service innovations in base of the pyramid markets. *Journal of Product Innovation Management*, 30(6), 1199-1211.
- Bhaskar, R. (1979). *The possibility of naturalism – a philosophical critique of the contemporary human sciences*. Sussex: Harvester Press.
- Bhaskar, R. (1998). *Possibility of naturalism*. Psychology Press.
- Blake, H. (2008). Mobile phone technology in chronic disease management. *Nursing Standard*, 23(12), 43-46.
- Boulos, M. N. K., Wheeler, S., Tavares, C., & Jones, R. (2011). How smartphones are changing the face of mobile and participatory healthcare: An overview, with example from eCAALYX. *BioMedical Engineering OnLine*, 10(1), 24-37.
- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27-40.
- Bowie, C., & Geubbels, E. (2013). *Epidemiology of maternal mortality in Malawi* (2nd Ed.). Malawi: Department of Community Health, College of Medicine.
- Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development*. Sage.
- Brady, F., Dyson, L. E., & Asela, T. (2008). Indigenous adoption of mobile phones and oral culture. *Cultural Attitudes Towards Communication and Technology 2008*, University of Sydney, Australia. 384-398.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- Buskens, I., & Webb, A. (2009). *African women and ICTs : Investigating technology, gender and empowerment*. Pretoria: UNISA Press.
- Butt, S., & Phillips, J. (2008). Personality and self reported mobile phone use. *Computers in Human Behavior*, 24(2), 346-360.

- Carlsson, S. A. (2012). The potential of critical realism in IS research. *Integrated Series in Information Systems*, 29, 281-304.
- Cattaneo, L. B., & Chapman, A. R. (2010). The process of empowerment: A model for use in research and practice. *American Psychologist*, 65(7), 646-659.
- Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. UK: Institute of Development Studies.
- Chan, C. V., & Kaufman, D. R. (2010). A technology selection framework for supporting delivery of patient-oriented health interventions in developing countries. *Journal of Biomedical Informatics*, 43(2), 300-306.
- Chi, B. H., & Stringer, J. S. (2010). Mobile phones to improve HIV treatment adherence. *The Lancet*, 376(9755), 1807-1808.
- Chib, A. (2010). The Aceh Besar midwives with mobile phones project: Design and evaluation perspectives using the information and communication technologies for healthcare development model. *Journal of Computer-Mediated Communication*, 15(3), 500-525.
- Chib, A., Lwin, M. O., Ang, J., Lin, H., & Santoso, F. (2008). Midwives and mobiles: Using ICTs to improve healthcare in Aceh Besar, Indonesia. *Asian Journal of Communication*, 18(4), 348-364.
- Chib, A., van Velthoven, M., & Car, J. (2014). mHealth adoption in low-resource environments: A review of the use of mobile healthcare in developing countries. *Journal of Health Communication*, (ahead-of-print), 1-31.
- Chib, A., Wilkin, H., Ling, L., Hoefman, B., & Van Biejma, H. (2012). You have an important message! Evaluating the effectiveness of a text message HIV/AIDS campaign in northwest Uganda. *Journal of Health Communication*, 17, 146-157.
- Chigona, W., Nyemba-Mudenda, M., & Metfula, A. (2012). A review on mHealth research in developing countries. *The Journal of Community Informatics*, 9(2). Retrieved from <http://ci-journal.net/index.php/ciej/article/view/941/1011>
- Choudhry, U. K. (1997). Traditional practices of women from India: Pregnancy, childbirth, and newborn care. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, 26(5), 533-539.
- Choudhury, N., & Ahmed, S. M. (2011). Maternal care practices among the ultra poor households in rural Bangladesh: A qualitative exploratory study. *BMC Pregnancy and Childbirth*, 11(1), 1-8.

- Clark, D. A. (2006). Capability approach. In D. A. Clark (Ed.), *The Elgar companion to development studies* (pp. 32-45). Cheltenham: Edward Elgar Publishing.
- Coeckelbergh, M. (2011). Human development or human enhancement? A methodological reflection on capabilities and the evaluation of information technologies. *Ethics & Information Technology*, 13(2), 81-92.
- Cole-Ceesay, R., Cherian, M., Sonko, A., Shivute, N., Cham, M., Davis, M., . . . Southall, D. (2010). Strengthening the emergency healthcare system for mothers and children in The Gambia. *Reproductive Health*, 7(21), 1-10.
- Cole-Lewis, H., & Kershaw, T. (2010). Text messaging as a tool for behavior change in disease prevention and management *Epidemiologic Reviews*, 32(1), 56-69.
- Conole, G., & Dyke, M. (2004). What are the affordances of information and communication technologies? *Association for Learning Technology Journal*, 12(2), 113-124.
- Corneille, M., Carter, L., Hall-Byers, N. M., Clark, T., & Younge, S. (2014). Exploring User Acceptance of a Text-Message Based Health Intervention. In *System Sciences (HICSS), 2014 47th Hawaii International Conference on 6 -9 January* (pp. 2759-2767). IEEE.
- Crawford, J., Larsen-Cooper, E., Jezman, Z., Cunningham, S. C., & Bancroft, E. (2014). SMS versus voice messaging to deliver MNCH communication in rural Malawi: Assessment of delivery success and user experience. *Global Health: Science and Practice*, 2(1), 35-46.
- Daft, R. L., & Lengel, R. (1984). Information richness: A new approach to managerial behaviour and organisational design. In L. Cummings, & B. Staw (Eds.), *Research in organisational behaviour* (6th Ed., pp. 191-233). Homewood IL: JAI Press.
- Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science*, 32(5), 554-571.
- Danermark, B., Ekström, M., Jakobsen, L., & Karlsson, J. (2002). *Explaining society: Critical realism in the social sciences*. Psychology Press.
- Darke, P., Shanks, G., & Broadbent, M. (1998). Successfully completing case study research: Combining rigour, relevance and pragmatism. *Information Systems Journal*, 8(4), 273-289.
- Datta, S., Ranganathan, P., & Sivakumar, K. (2014). A study to assess the feasibility of text messaging service in delivering maternal and child healthcare messages in a rural area of Tamil Nadu, India. *The Australasian Medical Journal*, 7(4), 175-180.

- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- De Tolly, K., Skinner, D., Nembaware, V., & Benjamin, P. (2012). Investigation into the use of short message services to expand uptake of human immunodeficiency virus testing, and whether content and dosage have impact. *Telemedicine and e-Health*, 18(1), 18-23.
- De Tolly, K., Technau, K., & Benjamin, P. (2009). *Helping HIV+ mothers protect their babies: Improving follow-up and HIV testing rates of exposed infants through SMS*. Unpublished manuscript.
- Deneulin, S. (2006). Individual well-being, migration remittances and the common good. *The European Journal of Development Research*, 18(1), 45-58.
- DeRenzi, B., Borriello, G., Jackson, J., Kumar, V. S., Parikh, T. S., Virk, P., & Lesh, N. (2011). Mobile phone tools for field-based health care workers in low-income countries. *Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine*, 78(3), 406-418.
- Dobson, P. J. (2001a). Longitudinal case research: A critical realist perspective. *Systemic Practice and Action Research*, 14(3), 283-296.
- Dobson, P. J. (2001b). The philosophy of critical realism—an opportunity for information systems research. *Information Systems Frontiers*, 3(2), 199-210.
- Dobson, P. J. (2012). Critical realism and IS research: Some methodological implications. *Research Methodologies, Innovations and Philosophies in Software Systems Engineering and Information Systems*, IGI Global, 63-68.
- Dobson, P., Myles, J., & Jackson, P. (2007). Making the case for critical realism: Examining the implementation of automated performance management systems. *Information Resources Management Journal (IRMJ)*, 20(2), 138-152.
- Donovan, K. P., & Martin, A. K. (2014). The rise of African SIM registration: The emerging dynamics of regulatory change. *First Monday*, 19(2).
- Duncombe, R. (2011). Researching impact of mobile phones for development: Concepts, methods and lessons for practice. *Information Technology for Development*, 17(4), 268-288.
- Easton, G. (2010). Critical realism in case study research. *Industrial Marketing Management*, 39(1), 118-128.

- Eastwood, J. G., Jalaludin, B. B., & Kemp, L. A. (2014). Realist explanatory theory building method for social epidemiology: A protocol for a mixed method multilevel study of neighbourhood context and postnatal depression. *SpringerPlus*, 3(1), 1-12.
- Ellis-Stoll, C. C., & Popkess-Vawter, S. (1998). A concept analysis on the process of empowerment. *Advances in Nursing Science*, 21(2), 62-68.
- Evans, W. D., Wallace, J. L., & Snider, J. (2012). Pilot evaluation of the text4baby mobile health program. *BMC public health*, 12(1), 1031.
- Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, 12(2), 219-245.
- Free, C., Phillips, G., Watson, L., Galli, L., Felix, L., Edwards, P., . . . Haines, A. (2013). The effectiveness of mobile-health technologies to improve health care service delivery processes: A systematic review and meta-analysis. *PLoS Medicine*, 10(1)
- Freedman, L. P., Graham, W. J., Brazier, E., Smith, J. M., Ensor, T., Fauveau, V., . . . Agarwal, K. (2007). Practical lessons from global safe motherhood initiatives: Time for a new focus on implementation. *The Lancet*, 370(9595), 1383-1391.
- Gasper, D. (2007). What is the capability approach?: Its core, rationale, partners and dangers. *Journal of Socio-Economics*, 36(3), 335-359.
- Gazmararian, J., Elon, L., Yang, B., Graham, M., & Parker, R. (2014). Text4baby program: an opportunity to reach underserved pregnant and postpartum women? *Maternal and child health journal*, 18(1), 223-232.
- Geçkil, E., Şahin, T., & Ege, E. (2009). Traditional postpartum practices of women and infants and the factors influencing such practices in south eastern Turkey. *Midwifery*, 25(1), 62-71.
- Gigler, B. (2004). Including the Excluded – Can ICTs empower poor communities? Towards an alternative evaluation framework based on the capability approach. *In 4th International conference on the capability approach*, 5(7).
- Gigler, B. (2006). Enacting and interpreting technology – from usage to well-being: Experiences of indigenous peoples with ICTs. In H. Rahman (Ed.), *Empowering marginal communities with information networking* (pp. 124-164). IGI Global.
- Gigler, B. (2011). Informational capabilities-the missing link for the impact of ICT on development. *E-Transform Knowledge Platform*. World Bank.

- Gomez, R., & Pather, S. (2012). ICT evaluation: Are we asking the right questions? *The Electronic Journal of Information Systems in Developing Countries*, 50(5), 1-14.
- Goodburn, E. A., Gazi, R., & Chowdhury, M. (1995). Beliefs and practices regarding delivery and postpartum maternal morbidity in rural Bangladesh. *Studies in Family Planning*, 26(1), 22-32.
- Grunfeld, H., Hak, S., & Pin, T. (2011). Understanding benefits realisation of iREACH from a capability approach perspective. *Ethics and Information Technology*, 13(2), 151-172.
- GSMA (2013). *Sub-saharan africa mobile economy 2013*. Retrieved from http://www.gsmamobileeconomy.com/ssa2013/Sub-Saharan%20Africa_ME_Report_English_2013.pdf
- Hafkin, N. J., & Huyer, S. (2006). *Cinderella or cyberella?: Empowering women in the knowledge society*. Bloomfield: Kumarian Press Inc.
- Han, C. (2012). South African perspectives on mobile phones: Challenging the optimistic narrative of mobiles for development. *International Journal of Communication*, 6 (25), 2057–2081.
- Hartley, J. (2004). Case study research. In C. Cassell, & G. Symon (Eds.), *Essential guide to qualitative research in organizational research* (pp. 323-333). London: Sage.
- Hatakka, M., Ater, S., Obura, D., & Mibei, B. (2014). Capability outcomes from educational and ICT capability Inputs—An analysis of ICT use in informal education in Kenya. *The Electronic Journal of Information Systems in Developing Countries*, 61(1), 1-17.
- Hatakka, M., & De', R. (2011). Development, capabilities and technology – an evaluative framework. In *Proceedings of the 11th International Conference on Social Implications of Computers in Developing Countries: Partners for Development-ICT Actors and Actions*.
- Hatakka, M., & Lagsten, J. (2012). The capability approach as a tool for development evaluation—analyzing students' use of Internet resources. *Information Technology for Development*, 18(1), 23-41.
- Heeks, R. (2008). ICT4D 2.0: The next phase of applying ICT for international development. *Computer*, 41(6), 26-33.
- Heeks, R. (2010). Do information and communication technologies (ICTs) contribute to development? *Journal of International Development*, 22(5), 625-640.

- Heeks, R., & Molla, A. (2009). *Compendium on impact assessment of ICT-for-development projects*. (Working Paper Series No. 978-1-905469-03-1). University of Manchester.
- Heffernan, C., Lin, Y., & Thomson, K. (2012). Drawing from development: Towards unifying theory and practice of ICT4D. *Journal of International Development*, 1-17.
- Hilbert, M. (2011). Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics. *Women's Studies International Forum*, 34(6), 479-489.
- Hogan, M. C., Foreman, K. J., Naghavi, M., Ahn, S. Y., Wang, M., Makela, S. M., . . . Murray, C. J. L. (2010). Maternal mortality for 181 countries, 1980–2008: A systematic analysis of progress towards millennium development goal 5. *The Lancet*, 375(9726), 1609-1623.
- Human Right Watch (2011). *Accountability for maternal health care in South Africa*. South Africa: Human Rights Watch.
- Hunt, P., & Mesquita, J. B. (2008). *Reducing maternal mortality: The contribution of the right to the highest attainable standard of health*. University of Essex: Human Rights Centre and UNFPA.
- Huq, N. L., Azmi, A. J., Quaiyum, M. A., & Hossain, S. (2014). Toll free mobile communication: Overcoming barriers in maternal and neonatal emergencies in rural Bangladesh. *Reproductive Health*, 11(52), 1-12.
- Huq, N. L., Koehlmoos, T., Azmi, A. J., Quaiyum, M., Mahmud, A., & Hossain, S. (2012). Use of mobile phone: Communication barriers in maternal and neonatal emergencies in rural bangladesh. *International Journal of Sociology and Anthropology*, 4(8), 226-237.
- Hur, M. H. (2006). Empowerment in terms of theoretical perspectives: Exploring a typology of the process and components across disciplines. *Journal of Community Psychology*, 34(5), 523-540.
- Huyer, S. (2006). Understanding gender equality and women's empowerment in the knowledge society. In N. Hafkin, & S. Huyer (Eds.), *Cindirella or cyberella?: Empowering women in the knowledge society* (pp. 15-48). Bloomfield: Kumarian Press Inc.
- ITU. (2010). *ICT statistics NewsLog: Women in developing countries less likely to own a mobile phone*. Retrieved from <http://www.itu.int/ITU-D/ict/newslog/Women+In+Developing+Countries+Less+Likely+To+Own+A+Mobile+Phone.aspx>

- ITU. (2011a). *The role of ICT in advancing growth in least developed countries (LDCs) trends, challenges and opportunities*. Retrieved from http://www.itu.int/ITU-D/ldc/turkey/docs/The_Role_of_ICT_in_Advancing_Growth_in_LDCs_Trends_Challenges_and_Opportunities.pdf
- ITU. (2011b). *The world in 2011: ICT facts and figures 2011*. Retrieved from <http://www.itu.int/ITU-D/ict/facts/2011/material/ICTFactsFigures2011.pdf>
- ITU. (2012). *Malawi country profile 2012*. Retrieved from <http://www.itu.int/ITU-D/ict/eve/DisplayCountry.aspx?code=MLW>
- ITU. (2013). *The world in 2013: ICT facts and figures 2013*. (). Geneva, Switzerland: <http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2013-e.pdf>
- James, J. (2006). The Internet and poverty in developing countries: Welfare economics versus a functionings-based approach. *Futures*, 38(3), 337-349.
- James, J. (2011). Sharing mobile phones in developing countries: Implications for the digital divide. *Technological Forecasting and Social Change*, 78(4), 729-735.
- Jareethum, R., Titapant, V., Tienthai, C., Viboonchart, S., Chuenwattana, P., & Chatchainoppakhun, J. (2008). Satisfaction of healthy pregnant women receiving short message service via mobile phone for prenatal support: A randomized controlled trial. *Medical Journal of the Medical Association of Thailand*, 91(4), 458-463.
- Kaewkungwal, J., Singhasivanon, P., Khamsiriwatchara, A., Sawang, S., Meankaew, P., & Wechsart, A. (2010). Application of smart phone in "better border healthcare program": A module for mother and child care. *BMC Medical Informatics and Decision Making*, 10(69), 1-12.
- Kanjo, C. (2011). Pragmatism or policy: Implications on health information systems success. *The Electronic Journal of Information Systems in Developing Countries*, 48(1), 1-20.
- Kaplan, B., & Maxwell, J. (2005). Qualitative research methods for evaluating computer information systems. In J. Anderson, & C. Aydin (Eds.), *Evaluating the organizational impact of healthcare information systems* (2nd Ed., pp. 30-55) Springer.
- Kaplan, W. (2006). Can the ubiquitous power of mobile phones be used to improve health outcomes in developing countries? *Globalization and Health, BioMed Central*, 2(9), 1-14.
- Kasenga, F., Hurtig, A. K., & Emmelin, M. (2010). HIV-positive women's experiences of a PMTCT programme in rural Malawi *Midwifery*, 26(1), 27-37.

- Khanna, A., Singh, A., Soni, J., Quraishi, H., & Quraishi, S. (2012). Edutainment based mobile phone games for health communication in India. In *3rd Mobile for Development (M4D) Conference, New Delhi, India*. 67-81.
- Kijsanayotin, B., Pannarunothai, S., & Speedie, S. M. (2009). Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model. *International Journal of Medical Informatics*, 78(6), 404-416.
- Kivunike, F. N., Ekenberg, L., Danielson, M., & Tusubira, F. F. (2013). Developing criteria for the evaluation of the ICT contribution to social and economic development. *SIG GlobDev Sixth Annual Workshop, Milano, Italy*. 1-24.
- Kivunike, F. N., Ekenberg, L., Danielson, M., & Tusubira, F. F. (2014). Towards a structured approach for evaluating the ICT contribution to development. *International Journal on Advances in ICT for Emerging Regions (ICTer)*, 7(1), 1-15.
- Klasnja, P., & Pratt, W. (2012). Healthcare in the pocket: Mapping the space of mobile-phone health interventions. *Journal of Biomedical Informatics*, 45(1), 184-198.
- Kleine, D. (2010). ICT4WHAT? Using the choice framework to operationalise the capability approach to development. *Journal of International Development*, 22(5), 674-692.
- Kleine, D. (2013). *Technologies of choice?: ICTs, development, and the capabilities approach*. MIT Press.
- Kreps, G. L., & Neuhauser, L. (2010). New directions in eHealth communication: Opportunities and challenges. *Patient Education and Counseling*, 78(3), 329-336.
- Krishna, S., Boren, S. A., & Balas, E. A. (2009). Healthcare via cell phones: A systematic review. *Telemedicine and e-Health*, 15(3), 231-240.
- Kyomuhendo, G. B. (2003). Low use of rural maternity services in Uganda: Impact of women's status, traditional beliefs and limited resources. *Reproductive Health Matters*, 11(21), 16-26.
- Lau, Y., Cassidy, T., Hacking, D., Brittain, K., Haricharan, H., & Heap, M. (2014). Antenatal health promotion via short message service at a midwife obstetrics unit in South Africa: A mixed methods study. *BMC Pregnancy and Childbirth*, 14(1), 284-292.
- Law, I., & Widdows, H. (2008). Conceptualising health: Insights from the capability approach. *Health Care Analysis*, 16(4), 303-314.

- Lawson, C. (2010). Technology and the extension of human capabilities. *Journal for the Theory of Social Behaviour*, 40(2), 207-223.
- Lee, A. (1994). Electronic mail as a medium for rich communication: An empirical investigation using hermeneutic interpretation. *MIS Quarterly*, 18(2), 143-157.
- Lee, S. (2011). Midwives' cell phone use and health knowledge in rural communities. *Journal of Health Communication*, 16(9), 1006-1023.
- Lemay, N. V., Sullivan, T., Jumbe, B., & Perry, C. P. (2012). Reaching remote health workers in Malawi: Baseline assessment of a pilot mHealth intervention. *Journal of Health Communication*, 17, 105-117.
- Lim, S., Xue, L., Yen, C., Chang, L., Chan, H., Tai, B., . . . Choolani, M. (2011). A study on Singaporean women's acceptance of using mobile phones to seek health information. *International Journal of Medical Informatics*, 80(12), 189-202.
- Little, A., Medhanyie, A., Yebyo, H., Spigt, M., Dinant, G., & Blanco, R. (2013). Meeting community health worker needs for maternal health care service delivery using appropriate mobile technologies in Ethiopia. *PloS One*, 8(10), e77563.
- Lori, J. R., & Bolye, J. (2011). Cultural childbirth practices, beliefs, and traditions in postconflict Liberia. *Health Care for Women International*, 32(6), 454-473.
- Lucas, H. (2008). Information and communications technology for future health systems in developing countries. *Social Science & Medicine*, 66(10), 2122-2132.
- Lund, S. (2009). *Wired mothers: Use of mobile phones to improve maternal and neonatal health in Zanzibar*. University of Copenhagen: Institute of International Health of the University of Copenhagen. Retrieved from <http://www.i-m-s.dk/files/publications/Stine%20Lund%20Wired%20Mothers.pdf>
- Lund, S., Hemed, M., Nielsen, B., Said, A., Said, K., Makungu, M., & Rasch, V. (2012). Mobile phones as a health communication tool to improve skilled attendance at delivery in Zanzibar: A cluster-randomised controlled trial. *An International Journal of Obstetrics & Gynaecology*, 119(10), 1256-1264.
- Lund, S., Nielsen, B., Hemed, M., Boas, I., Said, A., Said, K., . . . Rasch, V. (2014a). Mobile phones improve antenatal care attendance in Zanzibar: A cluster randomized controlled trial. *BMC Pregnancy and Childbirth*, 14(1), 29-39.

- Lund, S., Rasch, V., Hemed, M., Boas, I., Said, A., Said, K., . . . Nielsen, B. (2014b). Mobile phone intervention reduces perinatal mortality in Zanzibar: Secondary outcomes of a cluster randomized controlled trial. *Journal of Medical Internet Research*, 2(1).
- Luttrell, C., Quiroz, S., Scrutton, C., & Bird, K. (2009). *Understanding and operationalising empowerment*. London: Overseas Development Institute.
- MacLeod, B., Phillips, J., Stone, A., Walji, A., & Awoonor-Williams, J. (2012). The architecture of a software system for supporting community-based primary health care with mobile technology: The mobile technology for community health (MoTeCH) initiative in Ghana. *Online Journal of Public Health Informatics*, 4(1).
- Macueve, G., Mandlate, J., Ginger, L., Gaster, P., & Macome, E. (2009). Women's use of information and communication technologies in Mozambique: A tool for empowerment. In I. Buskens, & A. Webb (Eds.), *African women & ICTs: Investigating technology, gender and empowerment* (pp. 21-32).
- Madon, S., Sahay, S., & Sudan, R. (2007). E-government policy and health information systems implementation in Andhra Pradesh, India: Need for articulation of linkages between the macro and the micro. *The Information Society*, 23(5), 327-344.
- Mahmud, N., Rodriguez, J., & Nesbit, J. (2010). A text message-based intervention to bridge the healthcare communication gap in the rural developing world. *Technology & Health Care*, 18(2), 137-144.
- Maimbolwa, M. C., Yamba, B., Diwan, V., & Ransjö-Arvidson, A. (2003). Cultural childbirth practices and beliefs in Zambia. *Journal of Advanced Nursing*, 43(3), 263-274.
- Makoza, F., & Chigona, W. (2012). The outcomes of ICT diffusion and human development in Malawi. *International Journal of Information Communication Technologies and Human Development (IJICTHD)*, 4(4), 52-70.
- Makoza, F., Chigona, W., & Nyemba-Mudenda, M. (2014). Analysis of online media on social inclusion in maternal health discourse. *Journal of Health Informatics in Developing Countries*, 8(1), 26-37.
- Malawi NSO. (2012a). *Malawi population data sheet 2012*. Retrieved from http://www.nsomalawi.mw/images/stories/data_on_line/demography/census_2008/Malawi%20Population%20Data%20Sheet%202012.pdf
- Malawi NSO. (2012b). *Third Integrated Household Survey: Malawi 2010-2011*. Retrieved from http://www.nsomalawi.mw/images/stories/data_on_line/economics/ihs/IHS3/IHS3_Report.pdf

- Malawi NSO, & ORC Macro. (2011). *Malawi demographic and health survey 2010*. Retrieved from http://www.nsomalawi.mw/images/stories/data_on_line/demography/MDHS2010/MDHS2010%20report.pdf
- Malawi NSO, & UNICEF. (2008). *Multiple indicator cluster survey 2006: Monitoring the situation of children and women*. Retrieved from <http://www.nsomalawi.mw/nada/index.php/catalog/6>
- Malhotra, A., Kanesathasan, A., & Patel, P. (2012). Connectivity: How mobile phones, computers and the Internet can catalyze women's entrepreneurship. *International Center for Research on Women: Washington, DC*.
- Marshall, C., & Rossman, G. B. (2006). *Designing qualitative research* (4th Ed.). Thousand Oaks: Sage.
- Martins, N. (2006). Capabilities as causal powers. *Cambridge Journal of Economics*, 30(5), 671-685.
- Martins, N. (2007a). Ethics, ontology and capabilities. *Review of Political Economy*, 19(1), 37-53.
- Martins, N. (2007b). Realism, universalism and capabilities. *Review of Social Economy*, 65(3), 253-278.
- Martins, N. (2011). Sustainability economics, ontology and the capability approach. *Ecological Economics*, 72, 1-4.
- Maton, K. I. (2008). Empowering community settings: Agents of individual development, community betterment, and positive social change. *American Journal of Community Psychology*, 41(1), 4-21.
- McGrath, K. (2013). The potential of generative mechanisms for IS research. In 34th *International Conference on Information Systems*, Milan, Italy. 1-17.
- McQueen, S., Konopka, S., Palmer, N., Morgan, G., Bitrus, S., & Okoko, L. (2012). *mHealth compendium*. (1st Ed.), No. AID - OAA - C - II - 0016. Arlington: Management Sciences for Health [MSH].
- Mecheal, P., Batavia, H., Kaonga, N., Searle, S., Kwan, A., Goldberger, A., . . . Ossman, J. (2010). *Barriers and gaps affecting mHealth in low and middle income countries: Policy white paper*. Columbia University: Earth Institute & mHealth Alliance.

- Mendoza, G., Okoko, L., Morgan, G., Konopka, S., Ybarra, M. L., Biringi, R., . . . Wereko-Brobby, O. (2013). mHealth compendium. Volume two. *Computers Informatics Nursing*, 30(11), 587-595.
- Merton, R. K. (1968). *Social theory and social structure*. New York: Free Press.
- Meyer, S. B., & Lunnay, B. (2013). The application of abductive and retroductive inference for the design and analysis of theory-driven sociological research. *Sociological Research Online*, 18(1), 1-12.
- Mezirow, J. (1991). *Transformative dimensions of adult learning*. ERIC.
- Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education*, 1997(74), 5-12.
- mHealth Alliance. (2010). Maternal-newborn mHealth initiative (MMI). Retrieved from <http://www.mhealthalliance.org/content/maternal-newborn-mhealth-initiative-mmi>
- Mingers, J. (2004a). Critical realism and information systems: Brief responses to monod and klein. *Information and Organization*, 14(2), 145-153.
- Mingers, J. (2004b). Real-izing information systems: Critical realism as an underpinning philosophy for information systems. *Information and Organization*, 14(2), 87-103.
- Mingers, J., Mutch, A., & Willcocks, L. (2013). Critical realism in information systems research. *MIS Quarterly*, 37(3), 795-802.
- Ministry of Health [Malawi]. (2005). *Road map for accelerating the reduction of maternal and neonatal mortality and morbidity in Malawi*. Retrieved from http://www.unicef.org/malawi/MLW_resources_roadmap.pdf
- Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2(3), 192-222.
- Morris, C. (2009). Measuring participation in childhood disability: How does the capability approach improve our understanding? *Developmental Medicine & Child Neurology*, 51(2), 92-94.
- Morris, K. (2009). Mobile phones connecting efforts to tackle infectious disease *The Lancet Infectious Diseases*, 9(5) Retrieved from <http://instedd.org/news-media/publications/mobile-phones-connecting-efforts-to-tackle-infectious-disease/>

- Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, 1(2), 13-22.
- Mosedale, S. (2005). Assessing women's empowerment: Towards a conceptual framework. *Journal of International Development*, 17(2), 243-257.
- Mtingwi, J., & Van Belle, J. (2013). E-government and M-government readiness in Malawi. In Z. Mahmood (Ed.), *E-government implementation and practice in developing countries* (pp. 211-241). IGI Global.
- Munro, M. L., Lori, J. R., Boyd, C. J., & Andreatta, P. (2014). Knowledge and skill retention of a mobile phone data collection protocol in rural Liberia. *Journal of Midwifery & Women's Health*, 59(2), 176-183.
- Myers, M. D., & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and Organization*, 17(1), 2-26.
- Nanda, G., Switlick, K., & Lule, E. (2005). *Accelerating progress towards achieving the MDG to improve maternal health: A collection of promising approaches*. Washington, DC: World Bank. Retrieved from <http://siteresources.worldbank.org/HEALTHNUTRITIONANDPOPULATION/Resources/281627-1095698140167/NandaAcceleratingProgresswithCover.pdf>
- Narayan-Parker, D. (2005). *Measuring empowerment : Cross-disciplinary perspectives*. World Bank. Retrieved from <https://openknowledge.worldbank.org/handle/10986/7441>
- Ngabo, F., Nguimfack, J., Nwaigwe, F., Mugeni, C., Muhoza, D., Wilson, D., . . . Binagwaho, A. (2012). Designing and implementing an innovative SMS-based alert system (RapidSMS-MCH) to monitor pregnancy and reduce maternal and child deaths in Rwanda. *The Pan African Medical Journal*, 13(31), 1-15.
- Nglazi, M. D., Bekker, L., Wood, R., Hussey, G. D., & Wiysonge, C. (2013). Mobile phone text messaging for promoting adherence to anti-tuberculosis treatment: A systematic review. *BMC Infectious Diseases*, 13(566), 1-16.
- Noordam, A. C., Kuepper, B. M., Stekelenburg, J., & Milen, A. (2011). Improvement of maternal health services through the use of mobile phones. *Tropical Medicine & International Health*, 16(5), 622-626.
- Nussbaum, M. (2000). Women's capabilities and social justice. *Journal of Human Development*, 1(2), 219-247.

- Nussbaum, M. (2003). Capabilities as fundamental entitlements: Sen and social justice. *Feminist Economics*, 9(2-3), 33-59.
- Nyemba-Mudenda, M., & Chigona, W. (2013). The dynamics of involving intermediaries on user experiences and outcomes of mHealth initiatives: The case of a maternal healthcare intervention in Malawi. In *Health Informatics South Africa (HISA) 2013 Conference*.
- Ogwuegbu, C. C., & Eze, O. H. (2009). Ethical and social issues facing obstetricians in low-income countries. *Clinical Obstetrics and Gynecology*, 52(2), 237-249.
- Olatokun, W. M. (2009). Analysing socio-demographic differences in access and use of ICTs in Nigeria using the capability approach. *Issues in Informing Science and Information Technology*, 6, 479-496.
- Oosterlaken, I. (2011). Inserting technology in the relational ontology of Sen's capability approach. *Journal of Human Development and Capabilities*, 12(3), 425-432.
- Ortlipp, M. (2008). Keeping and using reflective journals in the qualitative research process. *The Qualitative Report*, 13(4), 695-705.
- Osborn, J. (2013). MOTECH. In J. Donner, & P. Mechael (Eds.), *mHealth in practice: Mobile technology for health promotion in the developing world* (pp. 100-118). Bloomsbury Academic: A&C Black.
- Oyeyemi, S. O., & Wynn, R. (2014). Giving cell phones to pregnant women and improving services may increase primary health facility utilization: A case-control study of a Nigerian project. *Reproductive Health*, 11(1), 1-8.
- Palys, T. (2008). Purposive sampling. In L. Given, & K. Saumure (Eds.). *The Sage Encyclopedia of Qualitative Research Methods, Vol 1&2*, (pp. 697-698). Sage.
- Paternoster, R., & Pogarsky, G. (2009). Rational choice, agency and thoughtfully reflective decision making: The short and long-term consequences of making good choices. *Journal of Quantitative Criminology*, 25(2), 103-127.
- Pather, S., & Uys, C. (2010). A strategy for evaluating socio-economic outcomes of an ICT4D programme. In *System Sciences (HICSS), 2010 43rd Hawaii International Conference on* (pp. 1-11). IEEE.
- Patomäki, H., & Wight, C. (2000). After postpositivism? the promises of critical realism. *International Studies Quarterly*, 44(2), 213-237.

- Patton, M. Q. (1990). *Qualitative evaluation and research methods* . (2nd ed.). Newburk Park: Sage.
- Pawson, R. (2010). Middle range theory and program theory evaluation: From provenance to practice. In J. Vaessen, & F. L. Leeuw (Eds.), *Mind the gap: Perspectives on policy evaluation and the social sciences* (pp. 171-202). New Jersey: Transaction Publishers.
- Pawson, R., & Manzano-Santaella, A. (2012). A realist diagnostic workshop. *Evaluation*, 18(2), 176-191.
- Pawson, R., & Tilley, N. (1997). *Realistic evaluation*. Sage.
- Pawson, R., & Tilley, N. (2004). *Realist evaluation*. Retrieved from http://www.communitymatters.com.au/RE_chapter.pdf
- Penn-Kekana, L., & Blaauw, D. (2002). *A rapid appraisal of maternal health services in South Africa: A health systems approach*. DFID. Retrieved from http://www.dfid.gov.uk/r4d/PDF/Outputs/HealthSysDev_KP/01-02_south_africa.pdf
- Pettersen, K. A., McDonald, N., & Engen, O. A. (2010). Rethinking the role of social theory in socio-technical analysis: A critical realist approach to aircraft maintenance. *Cognition, Technology & Work*, 12(3), 181-191.
- Ponterotto, J. G. (2005). Qualitative research in counseling psychology: A primer on research paradigms and philosophy of science. *Journal of Counseling Psychology*, 52(2), 126-136.
- Porter, G., Hampshire, K., Abane, A., Munthali, A., Robson, E., Mashiri, M., & Tanle, A. (2012). Youth, mobility and mobile phones in Africa: Findings from a three-country study. *Information Technology for Development*, 18(2), 145-162.
- Power, G., Dillon, E., & Cleary, F. (2010). Seamless mobile communications for mHealth. *Journal of eHealth Technology and Application*, 8(1), 32-35.
- Prata, N., Sreenivas, A., Vahidnia, F., & Potts, M. (2009). Saving maternal lives in resource-poor settings: Facing reality. *Health Policy*, 89(2), 131-148.
- Pundir, A. K., Sharma, P., Shukla, R., & Khurana, R. (2012). Mobile health in India. *Proceedings of the 3rd Mobile for Development (M4D) Conference, New Delhi, India*, 47-50.
- Ragin, C. C. (2004). Turning the tables: How case-oriented research challenges. In E. Brady, & D. Collier (Eds.), *Rethinking social inquiry: Diverse tools, shared standards* (pp. 27-42). Rowman & Littlefield.

- Ramachandran, D., Goswami, V., & Canny, J. (2010). Research and reality: Using mobile messages to promote maternal health in rural India. *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development*, London. 35-45.
- Ramesh, J., Carter, A. O., Campbell, M. H., Gibbons, N., Powlett, C., Moseley, H. S., . . . Carter, T. (2008). Use of mobile phones by medical staff at Queen Elizabeth Hospital, Barbados: Evidence for both benefit and harm. *The Journal of Hospital Infection*, 70(2), 160-165.
- Robeyns, I. (2000). *An unworkable idea or a promising alternative? Sen's capability approach reexamined* (Discussion paper). University of Leuven: Centre for Economics Studies.
- Robeyns, I. (2003). Sen's capability approach and gender inequality: Selecting relevant capabilities. *Feminist Economics*, 9(2), 61-92.
- Robeyns, I. (2005a). The capability approach: A theoretical survey. *Journal of Human Development*, 6(1), 93-114.
- Robeyns, I. (2005b). Selecting capabilities for quality of life measurement. *Social Indicators Research*, 74(1), 191-215.
- Robeyns, I. (2006). The capability approach in practice*. *Journal of Political Philosophy*, 14(3), 351-376.
- Rodwell, C. M. (1996). An analysis of the concept of empowerment. *Journal of Advanced Nursing*, 23(2), 305-313.
- Rogers, E. M. (1995). *Diffusion of innovations*. New York.
- Rogers, E. M. (2010). *Diffusion of innovations*. Simon and Schuster.
- Ronsmans, C., & Graham, W. J. (2006). Maternal mortality: Who, when, where, and why. *Lancet*, 368(9542), 1189-1200.
- Rossi, P. H., & Lipsey, M. W. (2004). *Evaluation: A systematic approach*. Sage.
- Ruane, J. (2005). *Essentials of research methods: A guide to social research*. Oxford: Blackwell Publishing.
- Ruger, J. P. (2006). Toward a theory of a right to health: Capability and incompletely theorized agreements. *Yale JL & Human.*, 18, 273.

- Ruger, J. P. (2010). Health capability: Conceptualization and operationalization. *American Journal of Public Health, 100*(1), 41-49.
- Saito, M. (2003). Amartya Sen's capability approach to education: A critical exploration. *Journal of Philosophy of Education, 37*(1), 17-33.
- Sayer, A. (1992). *Method in social science: A realist approach* (2nd ed.) Routledge.
- Sayer, A. (2000). *Realism and social science*. Sage.
- Schultze, U., & Avital, M. (2011). Designing interviews to generate rich data for information systems research. *Information and Organization, 21*(1), 1-16.
- Schwarzer, R., & Fuchs, R. (1996). Self-efficacy and health behaviours. In M. Conner, & P. Norman (Eds.), *Predicting health behaviour: Research and practice with social cognition models* (pp. 163-196). Buckingham: Open University Press.
- Seawright, J., & Gerring, J. (2008). Case selection techniques in case study research: A menu of qualitative and quantitative options. *Political Research Quarterly, 61*(2), 294-308.
- Seidel, S., & Urquhart, C. (2013). On emergence and forcing in information systems grounded theory studies: The case of Strauss and Corbin. *Journal of Information Technology, 28*(3), 237-260.
- Sein, M. K., & Furuholt, B. (2009). Intermediaries in ICT4D: The other "I". *Second Annual SIG GlobDev Workshop*, (pp.1 - 15).
- Selepe, H. L., & Thomas, D. J. (2000). The beliefs and practices of traditional birth attendants in the Manxili area of KwaZulu, South Africa: A qualitative study. *Journal of Transcultural Nursing, 11*(2), 96-101.
- Seljeskog, L., Sundby, J., & Chimango, J. (2007). Factors influencing women's choice of place of delivery in rural Malawi – an explorative study. *African Journal of Reproductive Health, 10*(3), 66-75.
- Sen, A. (1984). *Resources, values and development*. Harvard University Press.
- Sen, A. (1985). Well-being, agency and freedom: The Dewey lectures 1984. *The Journal of Philosophy, 82*(4), 169-221.
- Sen, A. (1992). *Inequality reexamined*. Oxford University Press.

- Sen, A. (1993). Capability and well-being. In Nussbaum, M., & Sen, A. (Eds.). *The quality of life*. Oxford: Blackwell Publishing.
- Sen, A. (1999). *Development as freedom*. New York: Knopf.
- Sen, A. (2002). Response to commentaries. *Studies in Comparative International Development*, 37(2), 78-86.
- Sen, A. (2004). Capabilities, lists, and public reason: Continuing the conversation. *Feminist Economics*, 10(3), 77-80.
- Sen, A. (2009). *The idea of justice*. Harvard University Press.
- Sen, A. (2010). The mobile and the world. *Information Technologies & International Development*, 6(SE), 1-3.
- Sheng, H., Nah, F. F., & Siau, K. (2005). Strategic implications of mobile technology: A case study using value-focused thinking. *The Journal of Strategic Information Systems*, 14(3), 269-290.
- Shirazi, F. (2012). Information and communication technology and women empowerment in Iran. *Telematics and Informatics*, 29(1), 45-55.
- Singhal, A., & Rogers, E. M. (2002). A theoretical agenda for entertainment?Education. *Communication Theory*, 12(2), 117-135.
- Sinha, C. (2005). Effect of mobile telephony on empowering rural communities in developing countries. *International Research Foundation for Development (IRFD) Conference on Digital Divide, Global Development and Information Society*, (pp. 4-8).
- Smith, M. L. (2006). Overcoming theory-practice inconsistencies: Critical realism and information systems research. *Information and Organization*, 16(3), 191-211.
- Smith, M. L., & Seward, C. (2005). Causal theories and citizenship: Bridging the theory-data gap in Sen's capability approach. In *5th International Conference on the Capability Approach*, Paris, France. (pp. 1-29).
- Smith, M. L., & Seward, C. (2009). The relational ontology of amartya Sen's capability approach: Incorporating social and individual causes. *Journal of Human Development and Capabilities*, 10(2), 213-235.
- Smith, M. L., Spence, R., & Rashid, A. T. (2011). Mobile phones and expanding human capabilities. *Information Technologies & International Development*, 7(3), 77-88.

- Sumner, A., & Tribe, M. A. (2008). *International development studies: Theories and methods in research and practice*. Sage.
- Sword, W. (1999). Accounting for presence of self: Reflections on doing qualitative research. *Qualitative Health Research, 9*(2), 270-278.
- Tamrat, T., & Kachnowski, S. (2012). Special delivery: An analysis of mHealth in maternal and newborn health programs and their outcomes around the world. *Maternal and Child Health Journal, 16*(5), 1092-1101.
- Tengland, P. (2007). Empowerment: A goal or a means for health promotion? *Medicine, Health Care and Philosophy, 10*(2), 197-207.
- Tengland, P. (2008). Empowerment: A conceptual discussion. *Health Care Analysis, Springer Netherlands, 16*(2), 77-96.
- Tezcan, B., Von Rege, I., Henkson, H., & Oteng-Ntim, E. (2011). Unified communication to reach vulnerable mothers. *Journal of Obstetrics & Gynaecology, 31*(2), 122-124.
- Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation, 27*(2), 237-246.
- Treatman, D., & Lesh, N. (2012). Strengthening community health systems with localized multimedia. In *Proceedings of the 3rd Mobile for Development (M4D) Conference, New Delhi, India*, (pp. 7-22).
- Trotter II, R. T. (2012). Qualitative research sample design and sample size: Resolving and unresolved issues and inferential imperatives. *Preventive Medicine, 55*(5), 398-400.
- UNDP. (2010). *Human development report 2010, the real wealth of nations: Pathways to human development*. Retrieved from http://hdr.undp.org/sites/default/files/reports/270/hdr_2010_en_complete_reprint.pdf
- UNICEF. (2013). Statistics on Malawi. Retrieved from http://www.unicef.org/infobycountry/malawi_statistics.html
- United Nations. (2010). *Secretary-general message on world telecommunication and information society day: 17 may, 2010*. Retrieved from <http://www.un.org/sg/statements/?nid=4544>
- Van Dijk, J. (2012). The evolution of the digital divide: The digital divide turns to inequality of skills and usage. In J. Bus, M. Crompton, M. Hildebrandt & G. Metakides (Eds.), *Digital enlightenment yearbook 2012* (pp. 57-75).

- Vaughan, D. (2011). The importance of capabilities in the sustainability of information and communications technology programs: The case of remote indigenous Australian communities. *Ethics & Information Technology*, 13(2), 131-150.
- Vélez, O., Okyere, P., Kanter, A., & Bakken, S. (2014). A usability study of a mobile health application for rural Ghanaian midwives. *Journal of Midwifery & Women's Health*, 59(2), 184-191.
- Venkatesh, V., Brown, S. A., & Bala, H. (2013). Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. *MIS Quarterly*, 37(1), 21-54.
- Verkerk, M. A., Busschbach, J. J. V., & Karssing, E. D. (2001). Health-related quality of life research and the capability approach of Amartya Sen. *Quality of Life Research*, 10(1), 49-55.
- Watson, A., & Sabumei, G. (2014). Maternal health phone line: Analysis of first phase results. *Contemporary PNG Studies: DWU Research Journal*, (19), 23-35.
- WHO. (1996). *Mother-baby package: Implementing safe motherhood in countries*. Retrieved from http://whqlibdoc.who.int/hq/1994/WHO_FHE_MSM_94.11_Rev.1.pdf
- WHO. (2009). *Integrated management of pregnancy and childbirth: WHO recommended interventions for improving maternal and new born health*. (No. WHO/MPS/07.05). Retrieved from http://whqlibdoc.who.int/hq/2007/who_mps_07.05_eng.pdf
- WHO. (2010). *Trends in maternal mortality: 1990-2008*. Retrieved from http://whqlibdoc.who.int/publications/2010/9789241500265_eng.pdf
- WHO. (2012). *Trends in maternal mortality: 1990-2010*. Retrieved from <http://www.who.int/reproductivehealth/publications/monitoring/9789241503631/en/>
- Wikgren, M. (2005). Critical realism as a philosophy and social theory in information science? *Journal of Documentation*, 61(1), 11-22.
- Wilkinson, S. E., & Callister, L. C. (2010). Giving birth: The voices of Ghanaian women. *Health Care for Women International*, 31(3), 201-220.
- Wilson, M., & Greenhill, A. (2004). Theory and action for emancipation: Elements of a critical realist approach. In B. Kaplan, D. Truex III, D. Wastell, T. Wood-Harper & J. DeGross (Eds.), *Information systems research: Relevant theory and informed practice* (pp. 667-674) Springer.

- WSIS. (2005). *World summit on the information society declarations*. Retrieved from <http://www.itu.int/wsis/docs/geneva/official/dop.html>
- Wynn, D., & Williams, C. K. (2012). Principles for conducting critical realist case study research in information systems. *MIS Quarterly*, 36(3), 787-810.
- Yin, R. K. (1994). *Case study research: Design and methods* (2nd ed.). Sage.
- Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Sage.
- Zachariadis, M., Scott, S., & Barrett, M. (2013). Methodological implications of critical realism for mixed-methods research. *MIS quarterly*, 37(3), 855-880.
- Zheng, Y. (2009). Different spaces for e-development: What can we learn from the capability approach? *Information Technology for Development*, 15(2), 66-82.
- Zheng, Y., & Stahl, B. C. (2012). Evaluating emerging ICTs: A critical capability approach of technology. In I. Oosterlaken, & J. Hoven (Eds.), *The capability approach, technology and design* (vol: 5 ed., pp. 57-76). Springer.
- Zheng, Y., & Walsham, G. (2008). Inequality of what? social exclusion in the e-society as capability deprivation. *Information Technology People*, 21(3), 222-243.
- Zimmermann, B. (2006). Pragmatism and the capability approach. *European Journal of Social Theory*, 9(4), 467-484.
- Zurovac, D., Talisuna, A. O., & Snow, R. W. (2012). Mobile phone text messaging: Tool for malaria control in Africa. *PLoS Medicine*, 9(2), e1001176.

11 APPENDICES

11.1 Appendix A: UCT ethics Approval

UNIVERSITY OF CAPE TOWN



Faculty of Commerce Ethics in Research Committee

Courier: Room 2.26 Leslie Commerce Building Upper Campus University of Cape Town
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19 September 2012

UCT/COM/091/2012

Mrs Mphatso Nyemba-Mudenda
Information Systems
University of Cape Town
Mphatso.Nyemba-Mudenda@uct.ac.za

Dear Researcher

Project title: The Impact of mHealth on Maternal Healthcare consumers in a Developing Country Context

This letter serves to confirm that the project entitled "**The Impact of mHealth on Maternal Healthcare consumers in a Developing Country Context**" as described in your final submitted protocol dated 20 August 2012 has been approved. You may proceed with the research.

Please note that if you make any substantial change in your research procedure that could affect the experiences of the participants, you must submit a revised protocol to the Committee for approval.

Best wishes for great success with your research.

Regards,

Harold Kincaid

Professor Harold Kincaid
Commerce Faculty Ethics in Research Committee

"OUR MISSION is to be outstanding teaching and research university,
educating for life and addressing the challenges facing our society."

11.2 Appendix B: A letter of Introduction



UNIVERSITY OF CAPE TOWN

Department of Information Systems
Leslie Commerce Building
Engineering Mall – Upper Campus
OR Private Bag – Rondebosch 7701
Cape Town
South Africa

Telephone: +27 21 650-2261

Fax: +27 21 650-2280

Dear Sir/Madam,

Re: The Impact of mHealth on Maternal Health Consumers in a Developing Country Context

My name is Mphatso Nyemba-Mudenda. I am a PhD student in Information Systems at the University of Cape Town, South Africa.

As a requirement for my PhD, I am working on research that seeks to understand the use of mobile technology in maternal health in a developing country context like Malawi. This study will help in providing evidence on the effectiveness and impact of mHealth interventions on maternal health consumers, not only for health-related outcomes but for overall quality of life leading to development. You have been selected to participate in this research because of your involvement in the mHealth project (name hidden) in Balaka District. The interview is going to take approximately 60 minutes and all information received will be used only for academic purposes and no confidential information will be shared with a third party.

As a respondent, you reserve the right not to answer a question(s) and to withdraw from the interview at any time. At the end of this study, all participants – who may be willing – will be allowed to have a copy of the thesis.

Thank you for your assistance and cooperation.

Sincerely,



Mphatso Nyemba-Mudenda

(Email: mphatso.nyemba-mudenda@uct.ac.za)

Supervisor:

Prof. Wallace Chigona

Associate Professor

*Department of Information Systems
University of Cape Town
Private Bag, Rondebosch 7701, South Africa
Tel: (O) 27 21 6504345*

Email: Wallace.Chigona@uct.ac.za

11.3 Appendix C: Consent form

CONSENT FORM

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented in the information letter about a study being conducted by Mphatso Nyemba-Mudenda of the Department of Information Systems at the University of Cape Town. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses.

I am also aware that excerpts from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous.

I was informed that I may withdraw my consent at any time without penalty by advising the researcher.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

YES NO

I agree to have my interview audio recorded.

YES NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

YES NO

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Witness Signature: _____

Date: _____

11.4 Appendix D – Interview Guides

Interview Guide – Maternal Health Consumers

- **General**

1. Name:.....
2. Age range: 16-18 19-21 22-24 25-29 30-34 35-39 40-44 45&above
3. Marital Status:.....
4. Tribe:.....
5. Religion:.....
6. Education level:.....
7. Livelihood:.....
8. Monthly Income: less than K5,000; K5,000-K9,999; K10,000-K14,999; K15,000-K19,999; Above K20 000
9. Number of children.....
10. Where do you live.....
11. Health facility for maternal care.....

- **General life**

12. What are the most important things in your life?
13. What challenges do you face in your life in general?
14. What challenges affect these important things in your life?
15. What do you do when you are faced with such challenges?

- **Mobile Phones**

16. Do you have a mobile phone?
17. If not, do you have access to a mobile phone?
18. How well can you operate a mobile phone?
19. What do you use the mobile phone for?

- **Intervention**

20. Do you have access to the mobile services offered for maternal health?
21. How did you hear about the mobile services offered for maternal health?
22. How did you sign-up for the mobile services offered for maternal health?
23. Was training provided for the mobile services offered for maternal health?
24. For how long have you been using the mobile service (s) for maternal healthcare?
25. In your own understanding, what is the mHealth intervention all about?
26. Why did you sign up for the mobile services offered for maternal health?
27. How do you access the mobile services offered for maternal health?
28. If using shared phone or community phones- Are you free to talk without disturbances or fear of being heard?
29. Would you say that using community or shared phone had any effect on your use of the mHealth intervention?

30. What type of mobile service(s) do you use for maternal health? (i.e. voice, sms)
31. What maternal services did/do you access using a mobile phone?
32. What aspects of mobile service use for maternal health did you value?
33. Why did you value this aspect(s) of the mobile service for maternal health?

- **Conversion factors for generating a capability set**

34. What would you say facilitated/encouraged your use of mobile technology for maternal health?
35. What challenges do you face in your life concerning maternal health?
36. How do these challenges affect your use of mobile technology for maternal health?
37. What challenges do you face when using the mHealth intervention?
38. What would you say was/is the reaction of people (i.e husband/family/friends) toward your use of mobile service for maternal health?

- **List of Capabilities (potential functionings)**

39. Why do you use the mobile services for maternal care?
40. How helpful is the mHealth intervention to your day to day life?
41. In your opinion, what are the opportunities that come with the use of mHealth in maternal care?
42. How best do you think this mHealth intervention can help you and other women in this community?
43. How does the use of mHealth in maternal care affect important things in your life?

- **Conversion factors affecting outcome**

44. In your opinion, what would you say enable your utilisation of the opportunities into desired results?
45. How do the challenges affect your opportunities that come with the use of mHealth in maternal care?
46. And what would you say hinder your utilisation of the opportunities into desired results?

- **Outcome(achieved functionings)**

47. How has the mHealth intervention benefited you?
48. What would you say are the results of this mHealth intervention?
49. What things are you able to do now because of this mHealth intervention?
50. How has the use of the mHealth intervention helped you to achieve your aspirations?

Interview guide – Partners

- **General**

1. Name:.....
2. Age range: 16-18 18-21 21-24 24-27 30-35 35-40 40-45 45&above
3. Gender:.....
4. Marital Status:.....
5. Tribe:.....
6. Religion:.....
7. Education level:.....
8. Village:
9. Designation/Relationship:.....
10. Nearest health facility for maternal care:.....

- **Intervention**

11. What is your understanding of this mHealth intervention?
12. What does your wife (and other women) use the mobile service in maternal health for?
13. What type of mobile service(s) is preferred by your wife and other women in this mHealth intervention?
14. Why do they prefer the above mentioned mobile service(s) for maternal health services?
15. Which ones don't the women like, and why?

- **Conversion factors for generating a capability set**

16. In your opinion, what would you say facilitated/encouraged women's use of mobile technology for maternal health?
17. In your opinion, what would you say hinders women's use of mobile technology for maternal health?
18. What challenges do women face in general, and also concerning maternal health?
19. How do these challenges affect the women's use of mobile technology for maternal health?

- **List of Capabilities (potential functionings)**

20. Why do women use the mobile services for maternal care?
21. In your opinion, what are the opportunities that come with the use of mHealth in maternal care for women?
22. How best do you think this mHealth intervention can help women in this community?

- **Conversion factors affecting outcome**

23. In your opinion, what would you say facilitate or restrict women to utilise the opportunities that come with the use of mHealth in maternal care into desired results?
24. What challenges affect women opportunities that come with the use of mHealth in maternal care?
25. How do the challenges affect the opportunities that come with the use of mHealth in maternal care?

- **Outcome(achieved functionings)**

26. Is there a difference between the women using the mHealth intervention and those not using the mHealth intervention?

27. What are the women able to do now that they use this mHealth intervention?

28. How has the intervention benefitted your wife and other women?

29. What are the outcomes of this mHealth intervention for the women?

Interview Guide – Community Volunteers

- **General**

1. Name:.....
2. Age range: 16-18 18-21 21-24 24-27 30-35 35-40 40-45 45&above
3. Gender:.....
4. Marital Status:.....
5. Tribe:.....
6. Religion:.....
7. Education level:.....
8. Village:
9. Designation/Relationship:.....
10. Nearest health facility for maternal care:.....
11. Do you have a relative of child-bearing age using the mHealth intervention?

- **Intervention**

12. What is your understanding of this mHealth intervention?
13. What does your role entail in this mHealth intervention?
14. What do women use the mobile service in maternal health for?
15. What type of mobile service(s) is preferred by the women in this mHealth intervention?
16. Why would you say they prefer the above mentioned mobile service(s) for maternal health services?
17. Which ones don't the women like, and why?

- **Conversion factors for generating a capability set**

18. In your opinion, what would you say facilitate/encourage women's use of mobile technology for maternal health?
19. In your opinion, what challenges do women face when using mobile technology for maternal health?
20. What challenges do women face in general, and also concerning maternal health?
21. How do these challenges affect the women's use of mobile technology for maternal health?

- **List of Capabilities (potential functionings)**

22. Why do women use the mobile services for maternal care?
23. In your opinion, what are the opportunities that come with the use of mHealth in maternal care for women?
24. How best do you think this mHealth intervention can help women in this community?

- **Conversion factors affecting outcome**

25. In your opinion, what would you say encourage/support women to utilise the opportunities that come with the use of mHealth in maternal care into desired results?
26. What challenges affect women opportunities that come with the use of mHealth in maternal care?

27. How do the challenges affect the opportunities that come with the use of mHealth in maternal care?

- **Outcome(achieved functionings)**

28. Is there a difference between the women using the mHealth intervention and those not using the mHealth intervention?

29. What are the women able to do now that they use this mHealth intervention?

30. How has the intervention benefitted the women in this community?

31. What are the outcomes of this mHealth intervention for the women?

Interview Guide – Health Personnel & HSAs

- **General**

1. Name:.....
2. Age range: 18-21 22-25 26-29 30-34 35-39 40-44 45-49 50 & Above
3. Gender:.....
4. Name of Health Facility:.....
5. Type of Health Facility:.....
6. Position:.....
7. Length of service (Experience):.....
8. What is the nature of your job, what do you do exactly?

- **Maternal Health**

9. What maternal health services are offered at this clinic?
10. What maternal health services do you find useful, and why?

- **Intervention**

11. What do you know about this mHealth intervention?
12. For how long has it been since it started working in the catchment area of this health centre?
13. How is this health centre involved with this mHealth intervention?
14. How are you involved in this intervention?
15. What are the benefits or advantages of the mHealth intervention for this health centre?
16. What are the challenges of mHealth for this health centre?
17. Has mHealth intervention brought any changes (positive or negative) to this health centre in maternal health services?
18. Have you observed any changes in the women seeking maternal health services due to the mHealth intervention?
19. What is your opinion of this mHealth intervention?

- **Conversion factors for generating a capability set**

20. In your opinion, what would you say facilitate women's use of the intervention?
21. In your opinion, what challenges do women face when using the intervention?
22. What challenges do women face in general, and also concerning maternal health?
23. How do these challenges affect the women's use of the mHealth intervention?
24. Do the women have family/community support in using the mobile service for maternal health?

- **List of Capabilities (potential functionings)**

25. Why do women use the mHealth intervention for maternal care?
26. In your opinion, what are the opportunities that come with the use of the mHealth intervention in maternal care for the women?
27. How best do you think this mHealth intervention can help women in this community?

- **Conversion factors affecting outcome**

28. In your opinion, what facilitates women's utilisation of the opportunities into desired results/outcome?
29. What challenges affect women's opportunities that come with the use of mHealth intervention?

30. How do the challenges affect the opportunities that come with the use of mHealth intervention in maternal care?

- **Outcome(achieved functionings)**

31. Is there a difference between maternal healthcare consumers using the intervention and those not using not using it?

32. In your opinion, how has the use of the mHealth helped the women?

33. What are the outcomes of this mHealth intervention?

Interview Guide– Implementing Agency & Development Agency

- **General**

1. Name:.....
2. Organisation:.....
3. Type of organisation (project involvement):.....
4. Position:.....
5. Length of Service Experience):.....
6. What is the nature of your job (what do you do exactly)?
7. How are you involved in the mHealth project?

- **Intervention**

8. What is this mHealth intervention all about?
9. Why this particular type of mHealth or mobile services for this intervention?
10. What were the initial objectives for the mHealth intervention?
11. Are the initial and current objectives for the mHealth intervention the same?
12. If “NO”, why? What has changed?
13. What facilitate/support the implementation of this mHealth intervention?
14. What challenges do you face in the implementation/operations of this mHealth intervention?
15. How have the maternal health consumers embraced the mHealth intervention?
16. How has the community embraced it?
17. Why do women use this mHealth intervention for maternal care?
18. In your opinion, what would you say facilitate women’s use of mobile technology for maternal health?
19. In your opinion, what would you say hinder women’s use of mobile technology for maternal health?
20. How best can this mHealth intervention benefit women in the communities?
21. In your opinion, what are the opportunities that come with the use of mHealth in maternal care for clients?
22. In your opinion, what would you say encourage or restrict the clients to utilise the opportunities that come with the use of mHealth in maternal care into desired results/outcome?
23. In your opinion, how has the use of the mHealth services helped the women?
24. What are the outcomes of this mHealth?

Focus Group Discussion with Maternal Health Consumers

1. What things do you value the most in your life?
2. What do you value in pregnancy and childbirth?
3. What type of mobile service(s) do you use for maternal health?
4. What would you say facilitate the use of mobile technology for maternal health?
5. What challenges do you face when using themHealth intervention for maternal health?
6. Why do you use mobile service(s) for maternal care?
7. How best can this intervention help/benefit you in pregnancy and childbirth, and general?
8. What would you say enable your utilisation of the opportunities generated from the use mobile technology in maternal health into desired results?
9. What would you say hinder your utilisation of the opportunities generated from the use mobile technology in maternal health into desired results?
10. What are the outcomes of this mHealth intervention?
11. How has the mHealth intervention benefitted you and the community?

11.5 Appendix E: Sample analysis table

SAMPLE OF THE DATA ANALYSIS TABLES

Concept	Category	Sub-Theme	Theme	Coded excerpts from transcript	
Relative advantage	Service convenience	Immediacy	Access services from home	"...there are some conditions which just need medical advice not treatment ... women do not just rush to the clinic, some of these problems are being dealt with from home."	
			Anytime access	"...the project is empowering the women because they can actually talk to a medical people anytime and that makes a whole lot of a difference. You know normally they have travel to health centres, staying on the queue for a long time before talking to a medical person. But now anytime at their convenience they can call and talk to a medical person"	
			Not walking to clinic unnecessarily	"...these women get help right here in the village. Before they could rush to the hospital with a problem and some could be just send back without any treatment, after walking such a long distance... these women are able to get help without walking long distances..."	
		Saving financial resources		Save transport money	"You can call them and explain your problem and they are able to help you right there...because when you are sick and get the proper medical attention or help you get better and can continue with your daily activities...and you save time, money and also energy by not walking a long distance to the clinic... "
				Save on consultation fees and medication	"when MSSM refers users to no-charge government health centers for further assessment of symptoms, participants reported that they still save money ... without MSSM they might have sought care at a traditional healer who charges fees for services or purchased medicines from a local pharmacy" "If I was not following the advice from MSSM I might have ended up with so many ailments with my pregnancy. And this would have made us spend more money on medication or medical help, or even hiring people to do some of the work that I am able to do myself now ...but by knowing what to do, it has helped us not to waste money on such but save it"
			Saving time	Save on time	"When you call them and they give you instructions or advice that would make you feel better at home without going to the hospital, then you are able to continue with your house chores instead of wasting time going to the clinic " "The time that I could have used to go to the hospital I

				<p>use it here at home to do house chores, even doing business...”</p> <p>“And it also helps them to know whether or not the local clinic has the medical treatment required for their condition. If the local clinic does not have the treatment, they are advised where to go to find the required treatment...”</p>
Quality of information	Meeting the needs of women	Problem resolved		“When I was pregnant I used to feel sick most of the time...when I went to talk to the doctor....they told me that I should reduce on doing too much work, standing for a long time and also being on the sun for a long time...I followed this advice and there was great change”
		Action taken		“My husband appreciates MSSM because he has seen its goodness or value...I was told the estimated date of delivery and when I told him, he was able to save and buy all the things required during childbirth and also things for the baby...”
	Reliable information	Time-specific information		They advise us not to do too much hard work and the weekly messages tells us what is happening with the baby inside...and we want to know what is happening at every stage. And because it is the truth we continue to receive the messages and use them. It is shading light on what is happening in pregnancy and also show us where we are going ... keeping us in the know.
		Advice working		“...they are getting good advice from the voice messages, and most of the things they hear from these messages happen exactly the same as explained, and also the problems they are helped with are solved through the advice that they get from the phone...”
	Alternative source of information	Only source of information in community		“I came home when I got pregnant from school...my family was not happy and everyone ignored me... Then I started talking to people on MSSM about my pregnancy. Instead of talking to elder women who have knowledge about pregnancy, I was just talking to them. When I feel strange like having pain in my tummy they would tell me what to do i.e. advising me that I should go to the hospital for immediate attention, and I would go to the hospital.”
		Provide up-date and detailed maternal information		“These women actually say that at ANC they are not told much, it is just brief and very little information. But the weekly messages they get from MSSM explain a lot of things in detail and in a clear way...”

Note: Single examples of extracts/quotations from the corpus were used because of word limitations for the thesis.

11.6 Appendix F: Full paper on mHealth in maternal health

MHEALTH DRIVERS FOR MATERNAL HEALTH OUTCOMES IN DEVELOPING COUNTRIES: A SYSTEMATIC REVIEW

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Abstract: The target of the Millennium Development Goal 5 (MDG5) is to improve maternal health. Most developing countries are lagging behind their targets and it is very unlikely that this target will be met. In an attempt to address the many challenges in maternal health, mobile technology in health (mHealth) is being considered among other interventions to improve maternal health outcomes in developing countries. Several studies have shown the potential of mHealth to improve health outcomes by highlighting the applications used and outcomes realised. This paper intends to provide an overview of the potential mechanisms contributing to maternal health outcomes for mHealth projects in developing countries. A systematic literature review of peer-reviewed articles on mHealth in maternal health, published between 2008 and 2014, was conducted. Five mHealth drivers were found to contribute to maternal health outcomes in developing countries: (i) accessibility to mobile communication; (ii) system usability and adaptation; (iii) service convenience; (iv) health institution resources; and (v) system integration. The results pave the way for understanding how mHealth interventions work in maternal health, and could be useful for policy formulation, programme planning, design, and implementation.

Keywords: mHealth, mHealth drivers, maternal health, developing countries

INTRODUCTION

Maternal health refers to the health of women during pregnancy, childbirth, and the postpartum period. One of the major concerns in maternal health is maternal mortality. WHO (2010, p.4) defines maternal mortality as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. About 800 women die every day from pregnancy and childbirth-related complications (WHO, 2012). Currently maternal mortality is unacceptably high, ranging from 210 000 to 358 000 every year; 99% of these deaths occur in developing countries (Hogan et al., 2010; WHO, 2010; WHO, 2012). Life time risk of maternal deaths in developing countries is high because of high mortality rates, coupled with high fertility rates (Ronsmans & Graham, 2006). Millennium Development Goal 5 (MDG 5) calls for a 75% reduction in maternal

mortality rates (MMR) around the world by 2015, but most developing countries are lagging behind on their targets (Hogan et al., 2010).

Health systems in developing countries have deployed a number of technical interventions to improve maternal health outcomes including: emergency obstetric care, skilled attendance and management of unsafe abortion, focused antenatal care, and family planning services (Adam, 2005; Penn-Kekana & Blaauw, 2002). Three-quarters of maternal deaths could be prevented if the women had access to the interventions that manage pregnancy and birth complications, especially emergency obstetric care. However, most women do not have access to health services due to delay in: (i) recognising the need for medical attention and decision-making process, (ii) arriving at a health facility, and (iii) receiving adequate and appropriate care at health facility (Hunt & Mesquita, 2008; Noordam et al., 2011). The main causes of the delays are lack of information, the position of women in society, distance to a health facility, weak health systems, poverty, lack of education, and cultural practices (Hunt & Mesquita, 2008; Noordam et al., 2011; Ronsmans & Graham, 2006; WHO, 2010).

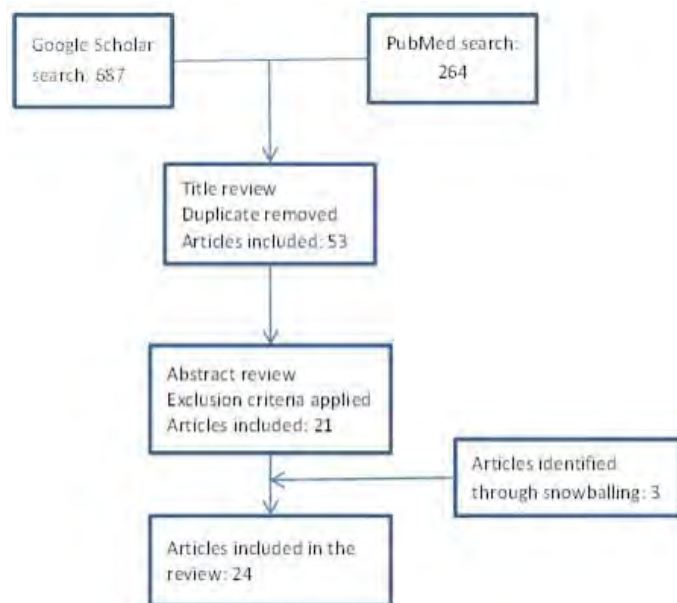
With 89% penetration rate in the developing world (ITU, 2013), mobile phones are becoming an important ICT tool, even in remote and rural areas of developing countries. The attributes of mobile phones, such as ubiquitous power, low cost, and ease of use, qualify them as an appropriate and adaptable tool for development (Blake, 2008; Duncombe, 2011). The use of mobile technology for healthcare service delivery (mHealth) is gaining popularity in developing countries (Aranda-Jan, Mohutsiwa-Dibe, & Loukanova, 2014; Chib, van Velthoven, & Car, 2014; Chigona, Nyemba-Mudenda, & Metfula, 2012). The benefits attributed to mHealth include increased access to health information and health services delivery, and improved efficiencies in data management in health systems of developing countries (Aranda-Jan et al., 2014; Mechael et al., 2010). However, poor infrastructure, both in technology and the health system, i.e., poor network coverage and poor conditions of health facilities respectively, pose a challenge to implementation of mHealth initiatives in developing countries (Aranda-Jan et al., 2014; Krishna, Boren, & Balas, 2009).

In most developing countries, the use of mHealth in maternal health involves innovative ways to reduce the delay in recognising the need for medical intervention, reaching a point of care, and receiving timely adequate care (Noordam et al., 2011). mHealth use in maternal health has potential to improve health outcomes for the mothers, communication among health workers, and data management in health facilities.

Various studies have demonstrated the potential benefits of mHealth, and factors affecting mHealth implementation in developing countries (e.g. Aranda-Jan et al., 2014). To the authors' knowledge, there is no study that has focused on maternal health in particular. The reviews on mHealth in maternal health (Noordam et al., 2011; Tamrat & Kachnowski, 2012) have focused on application and benefits of the mobile technology, with little attention to the causes of the outcomes. This paper discusses the potential determining factors of mHealth outcomes in maternal health that can pave the way to understand how mHealth works (or does not) for maternal health in developing countries. Data for the study is drawn from peer-reviewed papers that have evaluated mHealth projects for maternal health in developing countries.

METHODS

The authors conducted an electronic literature review in June-July 2014, using Google Scholar and PubMed databases. The search was done using combined terms relating to: mHealth, maternal health, and mobile telecommunications such as ‘mobile phone’, ‘cell phone’, ‘maternal healthcare’, ‘antenatal’, ‘health technolog*’, ‘informatics’, and others. The papers selected for the study were limited to English publications of peer-reviewed articles between 2008 and 2014, which yielded 951 articles, as illustrated in Figure 1.



Search and exclusion criteria for literature review

All potential abstracts were screened, and 24 studies were selected for full paper review after three were added to the corpus through snowballing. The exclusion criteria included: mHealth in maternal health studies in developed countries; studies not specific to maternal healthcare service delivery, i.e., fetal exposure to mobile phones; and studies on other related Information Communication Technologies (ICTs) such as eHealth and telemedicine, but not specific to mobile communication in maternal health. The 24 papers selected represented 19 mHealth projects; they focused on both: (i) Patients’ use of mobile technology to access maternal healthcare, and (ii) Healthcare providers’ use of mobile technology for management and provision of maternal healthcare. Almost half of the papers reviewed, 13, were from Africa, 10 from Asia, and one from Australia, Papua New Guinea.

The study employed the general inductive approach for analysing qualitative evaluation data, with the aim of unfolding the link between mHealth interventions and maternal health outcomes (Thomas, 2006). The authors familiarised themselves with the data by reading through the reviewed articles several times to identify themes; these themes were further grouped into categories, and then meaningful themes for determinants of mHealth outcomes in maternal health. The analysis was based on the following criteria: intervention type and objectives, the

outcomes, and factors affecting mHealth implementation. The criteria gave us an understanding of the necessary conditions in mHealth interventions that could have led to the outcomes realised.

FINDINGS

mHealth interventions in maternal health

mHealth in maternal health is still burgeoning. All the studies reviewed focused on pilot projects, with the exception of one project from Rwanda that had a nationwide deployment (Ngabo et al., 2012). The review showed that mHealth projects aim at increasing access to maternal healthcare services and increasing health facility utilisation. Two systematic reviews on mHealth in maternal health, Noordam et al. (2011) and Tamrat and Kachnowski (2012), have shown that mobile phone technology is basically used for:

- Demand generation for maternal healthcare services through health promotion and education
- Emergency obstetric referral, helping women access medical intervention on time
- Improving capacity of remote health workers through provision of point of care support, by connecting health personnel at different level facilities to transfer knowledge and share best practices
- Data collection and management, i.e. reporting and performance appraisal

The predominant mobile phone feature used in maternal health is SMS, which is used for disseminating health information (Datta, Ranganathan, & Sivakumar, 2014; Kaewkungwal et al., 2010; Lau et al., 2014); appointment reminders (Crawford et al., 2014; Lund et al., 2014a); and drug adherence (Ramachandran, Goswami, & Canny, 2010). Due to low literacy levels among women in developing countries, especially in remote areas, some projects (9 out of 19) used voice calls and voice messages where they deployed toll-free lines or provided credit to the users for patient consultation; linked health professionals of different levels and locations; and promoted health education and awareness (e.g. Crawford et al., 2014; Huq et al., 2014; Lund et al., 2012; MacLeod et al., 2012). Multimedia, in the form of audio and video combined with text messages, were used in one project in India to change what were considered harmful cultural beliefs and behaviour in pregnancy and childbirth through persuasion (Ramachandran et al., 2010). Some interventions used basic algorithms on mobile phones to improve data collection of health information and efficiencies in data management and reporting (Alam, Khanam, & Khan, 2010; Andreatta et al., 2011; Chib, 2010; Little et al., 2013; Vélez et al., 2014).

mHealth drivers

The analysis showed that the mHealth outcomes realised in maternal health in developing countries can be attributed to five key factors: (i) Accessibility to mobile communication; (ii) System usability and adaptation; (iii) Service convenience; (iv) Health institution resources; and

(v) System integration. Table 1 summarises the factors identified, and shows the papers from which they were drawn.

mHealth drivers in maternal health

mHealth drivers	Contributing factors	Studies
Accessibility to mobile communication	Low mobile phone ownership	Chib et al. (2008); Chib (2010); Alam et al. (2010); Huq et al. (2012, 2014); Oyeyemi and Wynn (2014); Crawford et al. (2014); Osborn (2013); MacLeod et al. (2012); Lund et al. (2012, 2014a, 2014b); Cole-Ceesay et al. (2010)
	Phone sharing	Datta et al. (2014); Lau et al. (2014); Huq et al. (2012, 2014); MacLeod et al. (2012); Crawford et al. (2014); Lund et al. (2012, 2014a, 2014b); Osborn (2013)
	Infrastructural barriers	Watson and Sabumei (2014); Ngabo et al. (2012); Cole-Ceesay et al. (2010); Osborn (2013); MacLeod et al. (2012); Crawford et al. (2014); Oyeyemi and Wynn (2014); Little et al. (2013); Chib et al. (2008)
	Cost of communication	All studies
System usability and adaptation	Ease of use	All studies
	Customisation to local realities	Ngabo et al. (2012); Little et al. (2013); Chib et al. (2008); Crawford et al. (2014); MacLeod et al. (2012); Watson and Sabumei (2014); Lund et al. (2012, 2014a, 2014b); Kaewkungwal et al. (2010); Huq et al. (2014); Osborn (2013)
Service convenience	Immediacy	All studies
	Interactivity (between patients and health workers, and among health workers)	MacLeod et al. (2012); Crawford et al. (2014); Ngabo et al. (2012); Watson and Sabumei (2014); Lund et al. (2012, 2014a, 2014b); Huq et al. (2012, 2014); Osborn (2013); Oyeyemi and Wynn (2014)
	Cost savings	Osborn (2013); Chib et al. (2008); Huq et al. (2012); Oyeyemi and Wynn (2014); Watson and Sabumei (2014); Little et al. (2013); Crawford et al. (2014)
	Confidentiality	Huq et al. (2012, 2014); Watson and Sabumei (2014); Osborn (2013)
	Reduced workload	Velez et al. (2014); Kaewkungwal et al. (2010); Alam et al. (2010); Chib (2010); Chib et al. (2008); Ngabo et al. (2012); Osborn (2013)

Health institution resources	Shortage of skilled workers	Cole-Ceesay et al. (2010); Watson and Sabumei (2014)
	Lack of medical resources and poor infrastructure	Watson and Sabumei (2014); Oyeyemi and Wynn (2014); Ramachandran et al. (2010); Cole-Ceesay et al. (2010)
System integration	Incorporation of mHealth into existing Health Information Systems (HIS)	Alam et al. (2010); Andreatta et al. (2011); Ngabo et al. (2012); Oyeyemi and Wynn (2014); Velez et al. (2014); Kaewkungwal et al. (2010); Huq et al. (2012, 2014); Little et al. (2013); Watson and Sabumei (2014);
	Involvement of health workers at different levels of healthcare	All studies with the exception of Lau et al. (2014); Crawford et al. (2014)

Accessibility to mobile communication

All the studies indicated that an initial step to mHealth is access to mobile phones. Despite the hype of increasing mobile phone penetration rates in developing countries, mobile phone ownership is still low, especially in remote areas (James & Versteeg, 2007; James, 2011). In a number of studies it was found that less than 50% of people in the local communities owned mobile phones. Most of these phones are owned by men or elders of the family. The unequal distribution of phones is mainly due to the high cost of telecommunications, and socio-cultural discrepancies that disadvantage women in developing countries, such as the low position of women in society (Huq et al., 2012; Lund et al., 2014b; MacLeod et al., 2012; Osborn, 2013). Thus, accessibility to a mobile phone for most women relied on sharing, which came with a number of challenges. A study in South Africa had a dropout rate of almost 50% for women who registered to receive educative text messages (Lau et al., 2014); one of the main reasons for this was shared phones. So even if messages were technically successfully delivered, some participants did not read them. Consequently, increase in health knowledge, intention to and actual behavioral change, were high in women using their own mobile phones (Crawford et al., 2014; Lau et al., 2014).

Infrastructural barriers such as poor mobile network coverage and limited electricity access in remote areas were mentioned in about 75% of the studies as having adverse effects on the accessibility of mobile communication. In some projects in Malawi, Ghana, Nigeria, Bangladesh, and Papua New Guinea, SMS messages were often not delivered and calls were dropped, due to poor network; mobile phones were switched off or were out of power due to limited electricity for charging (Crawford et al., 2014; Huq et al., 2014; MacLeod et al., 2012; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014). In contrast, good technological infrastructure, as in the case of Rwanda, made it possible for remote areas to have good mobile phone network coverage; this enhanced accessibility, contributing to the success of mHealth as a nationwide initiative.

The majority of the studies alluded to the impact of the cost of communication on the adoption of mHealth as a technology. Free services were found enabling for the women and the health

workers when using the interventions. Almost all of the studies concur that offering free mHealth services encouraged the uptake of intervention, because most people in the rural areas of developing countries, especially women, cannot afford the costs associated with mobile phone use, due to their low socio-economic status (Huq et al., 2014; Lund et al., 2014a; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014). In some cases communities would put money together for credit to continue accessing mHealth services, especially in emergency situations (Cole-Ceesay et al., 2010). Closed groups and a special free line have proved to be effective (Chib et al., 2008; Ngabo et al., 2012), as an open line could be misused and end up being costly for the project.

For community health workers (CHWs) and other health personnel, receiving free mobile phones was a motivation that boosted their engagement in the mHealth programmes (Andreatta et al., 2011; Chib et al., 2008; Huq et al., 2014; Little et al., 2013; Ngabo et al., 2012; Ramachandran et al., 2010; Vélez et al., 2014; Watson & Sabumei, 2014). The CHWs perceived as empowerment the fact that they could communicate with health facility staff while in the community and more still call an ambulance to fetch a woman from the village; this bestowed on them more respect and trust from the community, which they valued. Little et al. (2013) asserted that a sense of mobile phone ownership and empowerment act as a strong motivator for mobile phone use among health workers and, consequently, facilitate acceptability and accessibility of mHealth services.

System usability and adaptation

All the studies showed that mobile technology systems that adapt to local realities of communities in developing countries, along with ease of use, enhance mHealth acceptance and appropriation. Content, language, and mode of delivery were found to be crucial in a number of projects, particularly those dealing directly with women and CHWs (Crawford et al., 2014; Osborn, 2013). The health information disseminated needs to be locally generated content, in a language that the people understand, and be delivered in a way that they can comprehend (Huq et al., 2014; Lund et al., 2014a; MacLeod et al., 2012). The inability to read and comprehend text messages (most women were not literate) showed that SMS could fail to achieve desired outcomes (Crawford et al., 2014; Osborn, 2013).

To mitigate the literacy problem, some projects introduced voice calls and voice messages using the interactive voice response (IVR) system (Crawford et al., 2014; Huq et al., 2014; Osborn, 2013). In some cases users had challenges navigating the IVR system, and needed to be retrained. Most participants in several studies were familiar with a mobile phone. However, that did not translate to having knowledge of how to operate the devices. In a number of studies, participants needed to be shown how to operate a mobile phone at the beginning of the project, including health workers in some cases (Little et al., 2013; Ngabo et al., 2012; Vélez et al., 2014). For instance, in Liberia and Ghana, Traditional Birth Attendants (TBAs) were trained on how to use mobile phones for reporting maternal cases; the same had been done for midwives and CHWs who used mobile phones for data collection and reporting (Andreatta et al., 2011; Chib, 2010; Munro et al., 2014). Chib (2010) and Chib et al. (2008) noted that to enhance usability among health workers, a system needed to be appropriated in daily practices and *“should be seen as a dynamic response system rather than a method of policing, i.e., collecting*

data from the lower levels as a form of marking attendance and ensuring compliance” (Chib, 2010, p. 518).

Service convenience

mHealth services availed health information and services to the women anytime and anywhere; facilitated contact with health workers; reduced healthcare costs; reduced time response in emergencies; and reduced the workload of health workers in data management and reporting. These were all perceived to be useful to the participants. In almost all the studies, service convenience was hypothesised to impact patient satisfaction and healthcare utilisation for the mothers, by making it easier to acquire services (Cole-Ceesay et al., 2010; Lund et al., 2012; Oyeyemi & Wynn, 2014). It also impacted health service delivery by making it easier for health workers to report, organise, and manage data for decision making, planning, monitoring, and evaluation purposes (Chib, 2010; Jareethum et al., 2008; Little et al., 2013; Watson & Sabumei, 2014).

In the majority of the studies, the benefit of accessing health services at any time at the convenience of their communities was appreciated by the participants (Crawford et al., 2014; Datta et al., 2014; Oyeyemi & Wynn, 2014). This saved most of the women financial resources associated with transportation to a health facility (Huq et al., 2014; Lund et al., 2014a). mHealth services also increased contact with health workers, as women interacted with them frequently from home; this also gave the women confidence to go to the clinic, especially in Africa where negative attitudes of health workers is one of the barriers to women accessing healthcare (Lund et al., 2012). Confidentiality was another perceived advantage associated with talking to someone on the phone. Huq et al. (2012) found that the women were comfortable talking to someone they did not know and could not see, about sensitive problems they would rather not share in a face-to-face conversation, because no one in the community got to know about it. Some health workers found mobile phone communication private and confidential when discussing cases among health workers, compared to using high frequency radio systems (Watson & Sabumei, 2014).

The referrals to a health facility reduced time response to emergency cases, especially where the mobile phone system was linked to transport services of the health system (Cole-Ceesay et al., 2010; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014). Applications for data collection were associated with reduced workload for health workers, since they improved on the paper-based system if properly integrated in the health information system (Chib, 2010; Little et al., 2013; Ngabo et al., 2012; Vélez et al., 2014). This has also been found to enhance data management and real time reporting.

Health institution resources

ICTs such as mobile technology can enhance communication and processes for timely service delivery. However, community health programmes, complementary health facility resources, and infrastructure play a role in improving health outcomes. Poor health systems and infrastructure have adverse effects on the efficacy of mHealth in developing countries, and this was found to compromise health outcomes (Ngabo et al., 2012; Noordam et al., 2011; Tamrat & Kachnowski,

2012). A number of studies confirmed this hypothesis by showing that introducing mHealth intervention alone is not enough to improve health outcomes, and that mHealth effectiveness relies on the organisation of the health system (Ngabo et al., 2012; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014). Shortage of skilled health workers, lack of diagnosis and treatment resources, and poor logistics for emergency transport can adversely affect the effectiveness of an efficacy mHealth intervention (Cole-Ceesay et al., 2010; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014).

To test the assertions that access to free mHealth services by pregnant mothers and improving services at health facilities are more likely to increase primary healthcare utilisation, three studies were undertaken. In Nigeria, Papua New Guinea, and Gambia, the health systems in rural areas were completely overhauled and used for assessing the effectiveness of mHealth in improving emergency responses and utilisation of primary healthcare (Cole-Ceesay et al., 2010; Oyeyemi & Wynn, 2014; Watson & Sabumei, 2014). Oyeyemi and Wynn (2014) indicated that in their project the health facilities were renovated, transport infrastructure was improved, and all other resources were provided. Further, closed group mobile phones were provided to the mothers, CHWs, and health personnel to improve communication, referrals, and point of care support. The study found that free mobile phone services are more likely to increase utilisation of health facilities and reduce maternal deaths when health facility infrastructures and services are upgraded (Oyeyemi & Wynn, 2014). However, in Gambia and Papua New Guinea, after the improvements to the health system, those concerned still faced problems of shortage of skilled staff and limited funding for emergency transportation (Cole-Ceesay et al., 2010; Watson & Sabumei, 2014).

System integration

Three quarters of the projects in the reviewed studies had in one way or another integrated the mHealth intervention into the health system. System integration was twofold: the incorporation of the mHealth system into the existing health information system (HIS), whether electronic or paper-based; and the involvement of health workers in mHealth projects. Some projects worked in isolation without involving the health workers or incorporating the mHealth component into the existing HIS (e.g. Crawford et al., 2014; Lau et al., 2014). Such projects have problems in evaluating the impact of the intervention on health outcomes. Other projects involved health workers but the system ran in isolation (Jareethum et al., 2008; Ramachandran et al., 2010). The systems that were appropriated in the daily practices of health facilities and incorporated into HIS, in addition to involving health personnel, had the potential of realising maximum benefits from mHealth (Alam et al., 2010; Little et al., 2013; Ngabo et al., 2012; Vélez et al., 2014). With these two last models, the challenges encountered included health workers complaining of an additional workload to their busy schedule (Little et al., 2013; Vélez et al., 2014).

From the peer-reviewed articles, the only mHealth project that had been scaled nationwide was the RapidSMS in Rwanda (Ngabo et al., 2012). RapidSMS was fully integrated into the health system of Rwanda by deploying a two-way communication for action between the community, using CHWs, and the rest of the health system, for effective and timely maternal healthcare service. The system linkage included the transport system (ambulances), health facility staff, district hospital, and the central level through mobile phones. Further, the system provided a

database for clinical record-keeping for easy monitoring of maternal cases and service delivery. According to Ngabo et al. (2012), the main reason for RapidSMS's success was that it leveraged the structured and strong community-based health programme of the Rwandan health system: CHWs were stationed in villages for the purpose of identifying pregnant women to monitor their pregnancy by making regular follow-ups during and after pregnancy, and making sure that they delivered at a health facility. The mHealth project simply enhanced the processes of the system that was already in place. Government commitment to innovation in healthcare made it easier to take ownership for scaling the programme nationwide after donor funds had run out (Ngabo et al., 2012).

In Zanzibar, the use of SMSs in monitoring pregnancy, coupled with mobile phone calls for emergency referrals and point of care support in health facilities which were fully integrated into the HIS, increased antenatal care (ANC) attendance and health facility delivery, and reduced perinatal mortality⁹, which is a sensitive indicator of MMR (Lund et al., 2012; 2014a; 2014b). This is one of the pioneering studies in mHealth that evaluated the effectiveness of the technology, based on the primary health outcome of reduced perinatal deaths (Lund et al., 2014b). Chib (2010); Chib et al. (2008); and Ngabo et al. (2012) also demonstrated the importance of grassroot health workers' access to higher level health personnel for consultation and guidance to serve the women better; this has a positive effect on the use of mobile phones to improve health outcomes.

System integration enhances engagement of health personnel in different levels of the health system; it further improves the skills of remote health workers, as it affords them an opportunity to learn from workers in higher levels, e.g., in hospitals (Chib, 2010; Little et al., 2013; Vélez et al., 2014; Watson & Sabumei, 2014).

DISCUSSION AND CONCLUSION

The review provides an overview of potential determinants of mHealth outcomes in maternal health in developing countries. The initial step to realising health outcomes using mHealth is accessibility to mobile communication. It was noted that women's access to mobile phones in developing countries is constrained by high cost of communication and the gender digital divide, which is aggravated by discrepancies in literacy, income status, and employment (Hilbert, 2011). Most women rely on shared mobile phones for communication, for which they have to seek permission from their husbands or elders. Involvement of key stakeholders in mHealth projects, especially at community level, i.e., people with authority over women's lives, may improve access, acceptance, and usage of mHealth services. In addition, government and the telecommunication industry involvement and support may mitigate the challenges of the high

⁹ Perinatal mortality refers to death around the time of delivery, including both fetal deaths (at least 20 weeks of gestation) and early infant (neonatal) deaths

cost of communication in health, e.g., getting subsidised rates and network coverage in rural areas.

Similar to any technological innovation, ease of use and perceived usefulness are the key contributing factors to acceptance and adoption of mHealth. From the existing studies it can be concluded that the perception of usefulness is more often more important than ease of use (Chib, 2010; Huq et al., 2014; Vélez et al., 2014). The convenience of mHealth services for the women ranged from immediacy, interactivity, time and cost savings, and confidentiality. The women in maternal health find timely targeted information that they receive in the convenience of their homes/communities useful as it saves them unnecessary trips to a health facility. This yields economic benefits of saved time and money. Even though mHealth is reported to reduce the workload for the health workers, if not properly integrated and managed in the health information system (HIS), it can double the workload of the already overburdened staff. mHealth needs to be incorporated into the work practices and processes so as to enhance efficiencies. Adaptation to local realities was found to be one of the critical success factors for mHealth in maternal health, especially if it mitigates barriers of language, illiteracy, and culture – resulting in appropriation of mHealth services.

Poor access to health information is only one among many factors (e.g., shortage of staff) that has led to poor maternal health outcomes in developing countries (Hogan et al., 2010; Oyeyemi & Wynn, 2014). Therefore, improving access to health information is not, by itself, sufficient to significantly reduce maternal morbidity and mortality in developing countries. The review has shown that the use of mHealth can improve access to health information, data management, and service delivery; but it does not improve the poor conditions of health systems in developing countries that are in dire need of refurbishment. Improving services at health facilities and pregnant women's access to free mobile phone services have great potential to increase utilisation of the primary healthcare system. With the poor conditions of health systems in developing countries, mHealth, just like other ICTs, fails to reflect any significant positive impact on health outcomes, especially when health indicators are used. Furthermore, integration of mHealth into the existing HIS and involvement of health workers at all levels of healthcare, facilitate efficiencies in the provision of care. The studies have shown that achieving a strong sense of ownership and empowerment among health workers is a prerequisite for the successful introduction of any mHealth programme (Little et al., 2013; Ngabo et al., 2012).

Accessibility and usability of mobile communications are necessary conditions for maternal health consumers and health workers to leverage mobile phones for maternal healthcare. The beliefs that mHealth users form about the technology, and the perceived advantages of the system/services, influence their acceptance and use. However, while these conditions are necessary, they are not sufficient to effect positive change in maternal health. Health institution resources and integrating mHealth interventions into existing health systems were found to be vital for provision of timely adequate care for the women. The literature is consistent that mHealth has potential to improve maternal health outcomes, but the success of mHealth interventions in maternal health does not only depend on technology acceptance, and adoption, but also on the organisation of the health system (Aranda-Jan et al., 2014; Chib et al., 2014; Krishna et al., 2009). System integration, if designed and implemented properly through collaboration with all key stakeholders, may enhance efficiencies in the health system and

improve access to health information and services, as well as health worker consultation and guidance that can improve health outcomes in maternal health.

Findings of this study can help designers and developers of mHealth systems, implementers of mHealth interventions, policy makers, and researchers understand better the factors that affect the acceptance and use of mobile phone technology, and how mHealth contributes to maternal health outcomes. Positive factors can be incorporated in planning, design, and implementation of mHealth projects; while, for the negative ones, mitigation strategies can be taken into consideration. Even though the study focused on mHealth interventions in the domain of maternal health, the findings can be used to gain insights into mobile technology use in healthcare in general.

The study had two main limitations. First, only studies published in English were included; this excluded studies published in other languages. Second, the review considered peer-reviewed articles only, excluding the numerous reports on mHealth in maternal health in grey literature. This decision was made to ensure the quality of the articles being reviewed. However, we acknowledge that the articles excluded from the study could have added critical insights to the study. We also acknowledge that quantitative approaches could have added rigour and insight to the study.

REFERENCES AND CITATIONS

- Adam, T. (2005). Cost effectiveness analysis of strategies for maternal and neonatal health in developing countries. *BMJ. British Medical Journal*, 331(7525), 1107.
- Alam, M., Khanam, T., & Khan, R. (2010). Assessing the scope for use of mobile based solution to improve maternal and child health in Bangladesh: A case study. *In Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development* (p. 3). ACM.
- Andreatta, P., Debuur, D., Danquah, A., & Perosky, J. (2011). Using cell phones to collect postpartum haemorrhage outcome data in rural Ghana. *International Journal of Gynaecology & Obstetrics*, 113(2), 148-151.
- Aranda-Jan, C. B., Mohutsiwa-Dibe, N., & Loukanova, S. (2014). Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa. *BMC Public Health*, 14(188), 1-15.
- Blake, H. (2008). Mobile phone technology in chronic disease management. *Nursing Standard*, 23(12), 43-46.
- Chib, A. (2010). The Aceh Besar midwives with mobile phones project: Design and evaluation perspectives using the information and communication technologies for healthcare development model. *Journal of Computer-Mediated Communication*, 15(3), 500-525.
- Chib, A., Lwin, M. O., Ang, J., Lin, H., & Santoso, F. (2008). Midwives and mobiles: Using ICTs to improve healthcare in Aceh Besar, Indonesia. *Asian Journal of Communication*, 18(4), 348-364.

- Chib, A., van Velthoven, M., & Car, J. (2014). mHealth adoption in low-resource environments: A review of the use of mobile healthcare in developing countries. *Journal of Health Communication*, 1-53.
- Chigona, W., Nyemba-Mudenda, M., & Metfula, A. (2012). A review on mHealth research in developing countries. *The Journal of Community Informatics*, 9(2). Retrieved from <http://ci-journal.net/index.php/ciej/article/view/941/1011>
- Cole-Ceesay, R., Cherian, M., Sonko, A., Shivute, N., Cham, M., Davis, M., Southall, D. (2010). Strengthening the emergency healthcare system for mothers and children in the Gambia. *Reproductive Health*, 7(21)
- Crawford, J., Larsen-Cooper, E., Jezman, Z., Cunningham, S. C., & Bancroft, E. (2014). SMS versus voice messaging to deliver MNCH communication in rural Malawi: Assessment of delivery success and user experience. *Global Health: Science and Practice*, 2(1), 35-46.
- Datta, S., Ranganathan, P., & Sivakumar, K. (2014). A study to assess the feasibility of text messaging service in delivering maternal and child healthcare messages in a rural area of Tamil Nadu, India. *The Australasian Medical Journal*, 7(4), 175-180.
- Duncombe, R. (2011). Researching impact of mobile phones for development: Concepts, methods and lessons for practice. *Information Technology for Development*, 17(4), 268-288.
- Hilbert, M. (2011). Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics. *Women's Studies International Forum*, 34(6), 479-489.
- Hogan, M. C., Foreman, K. J., Naghavi, M., Ahn, S. Y., Wang, M., Makela, S. M., Murray, C. J. L. (2010). Maternal mortality for 181 countries, 1980–2008: A systematic analysis of progress towards millennium development goal 5. *The Lancet*, 375(9726), 1609-1623.
- Hunt, P., & Mesquita, J. B. (2008). *Reducing maternal mortality: The contribution of the right to the highest attainable standard of health*. Retrieved from http://www.unfpa.org/webdav/site/global/shared/documents/publications/reducing_mm.pdf
- Huq, N. L., Azmi, A. J., Quaiyum, M. A., & Hossain, S. (2014). Toll free mobile communication: Overcoming barriers in maternal and neonatal emergencies in rural Bangladesh. *Reproductive Health*, 11(52). 1-12.
- Huq, N. L., Koehlmoos, T., Azmi, A. J., Quaiyum, M., Mahmud, A., & Hossain, S. (2012). Use of mobile phone: Communication barriers in maternal and neonatal emergencies in rural Bangladesh. *International Journal of Sociology and Anthropology*, 4(8), 226-237.
- ITU (2013). *The world in 2013: ICT facts and figures 2013*. International Telecommunication Union. retrieved from <http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2013-e.pdf>
- James, J. (2011). Sharing mobile phones in developing countries: Implications for the digital divide. *Technological Forecasting and Social Change*, 78(4), 729-735.
- James, J., & Versteeg, M. (2007). Mobile phones in Africa: How much do we really know? *Social Indicators Research*, 84(1), 117-126.

- Jareethum, R., Titapant, V., Tienthai, C., Viboonchart, S., Chuenwattana, P., & Chatchainoppakhun, J. (2008). Satisfaction of healthy pregnant women receiving short message service via mobile phone for prenatal support: A randomized controlled trial. *Medical Journal of the Medical Association of Thailand, 91*(4), 458.
- Kaewkungwal, J., Singhasivanon, P., Khamsiriwatchara, A., Sawang, S., Meankaew, P., & Wechsart, A. (2010). Application of smart phone in "better border healthcare program": A module for mother and child care. *BMC Medical Informatics and Decision Making, 10*(1), 69.
- Krishna, S., Boren, S. A., & Balas, E. A. (2009). Healthcare via cell phones: A systematic review. *Telemedicine and e-Health, 15*(3), 231-240.
- Lau, Y., Cassidy, T., Hacking, D., Brittain, K., Haricharan, H., & Heap, M. (2014). Antenatal health promotion via short message service at a midwife obstetrics unit in South Africa: A mixed methods study. *BMC Pregnancy and Childbirth, 14*(1), 284.
- Little, A., Medhanyie, A., Yebyo, H., Spigt, M., Dinant, G., & Blanco, R. (2013). Meeting community health worker needs for maternal healthcare service delivery using appropriate mobile technologies in ethiopia. *PloS One, 8*(10).
- Lund, S., Hemed, M., Nielsen, B. B., Said, A., Said, K., Makungu, M. H., & Rasch, V. (2012). Mobile phones as a health communication tool to improve skilled attendance at delivery in Zanzibar: A cluster-randomised controlled trial. *An International Journal of Obstetrics & Gynaecology, 119*(10), 1256-1264.
- Lund, S., Nielsen, B., Hemed, M., Boas, I., Said, A., Said, K., Rasch, V. (2014a). Mobile phones improve antenatal care attendance in Zanzibar: A cluster randomized controlled trial. *BMC Pregnancy and Childbirth, 14*(1), 29.
- Lund, S., Rasch, V., Hemed, M., Boas, I., Said, A., Said, K., Nielsen, B. (2014b). Mobile phone intervention reduces perinatal mortality in Zanzibar: Secondary outcomes of a cluster randomized controlled trial. *Journal of Medical Internet Research, 16*(3).
- MacLeod, B., Phillips, J., Stone, A., Walji, A., & Awoonor-Williams, J. (2012). The architecture of a software system for supporting community-based primary healthcare with mobile technology: The mobile technology for community health (MoTeCH) initiative in Ghana. *Online Journal of Public Health Informatics, 4*(1).
- Michael, P., Batavia, H., Kaonga, N., Searle, S., Kwan, A., Goldberger, A., Ossman, J. (2010). *Barriers and gaps affecting mHealth in low and middle income countries: Policy white paper*. Columbia University: Earth Institute & mHealth Alliance.
- Munro, M. L., Lori, J. R., Boyd, C. J., & Andreatta, P. (2014). Knowledge and skill retention of a mobile phone data collection protocol in rural Liberia. *Journal of Midwifery & Women's Health, 59*(2), 176-183.
- Ngabo, F., Nguimfack, J., Nwaigwe, F., Mugeni, C., Muhoza, D., Wilson, D., Binagwaho, A. (2012). Designing and implementing an innovative SMS-based alert system (RapidSMS-MCH) to monitor pregnancy and reduce maternal and child deaths in Rwanda. *The Pan African Medical Journal, 13*(31)

- Noordam, A. C., Kuepper, B. M., Stekelenburg, J., & Milen, A. (2011). Improvement of maternal health services through the use of mobile phones. *Tropical Medicine & International Health*, 16(5), 622-626.
- Osborn, J. (2013). MOTECH. In J. Donner, & P. Mechael (Eds.), *mHealth in practice: Mobile technology for health promotion in the developing world* (pp. 100-118). London: Bloomsbury Academic: A&C Black.
- Oyeyemi, S. O., & Wynn, R. (2014). Giving cell phones to pregnant women and improving services may increase primary health facility utilization: A case-control study of a Nigerian project. *Reproductive Health*, 11(1), 1-8.
- Penn-Kekana, L., & Blaauw, D. (2002). *A rapid appraisal of maternal health services in South Africa: A health systems approach*. (). UK: DFID. Retrieved from http://www.dfid.gov.uk/r4d/PDF/Outputs/HealthSysDev_KP/01-02_south_africa.pdf
- Ramachandran, D., Goswami, V., & Canny, J. (2010). Research and reality: Using mobile messages to promote maternal health in rural india. *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development*, London.
- Ronsmans, C., & Graham, W. J. (2006). Maternal mortality: Who, when, where, and why. *Lancet*, 368(9542), 1189-1200.
- Tamrat, T., & Kachnowski, S. (2012). Special delivery: An analysis of mHealth in maternal and newborn health programs and their outcomes around the world. *Maternal and Child Health Journal*, 16(5), 1092-1101.
- Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation*, 27(2), 237-246.
- Vélez, O., Okyere, P., Kanter, A., & Bakken, S. (2014). A usability study of a mobile health application for rural Ghanaian midwives. *Journal of Midwifery & Women's Health*, 59(2), 184-191.
- Watson, A., & Sabumei, G. (2014). Maternal health phone line: Analysis of first phase results. *Contemporary PNG Studies: DWU Research Journal*, (19), 23.
- WHO. (2010). *Trends in maternal mortality: 1990-2008*. World Health Organisation. Retrieved from http://whqlibdoc.who.int/publications/2010/9789241500265_eng.pdf
- WHO. (2012). *Trends in maternal mortality: 1990-2010*. World Health Organisation. Retrieved from http://whqlibdoc.who.int/publications/2012/9789241503631_eng.pdf?ua=1

11.7 Appendix G: List of fixed Capabilities

A list of Central Human Capabilities

Category	Capabilities
<i>Life</i>	Being able to live to the end of a human life of normal length; not dying prematurely, or before one's life is so reduced as to be not worth living
<i>Bodily Health</i>	Being able to have good health, including reproductive health; to be adequately nourished; to have adequate shelter
<i>Bodily Integrity</i>	Being able to move freely from place to place; to be secure against violent assault, including sexual assault and domestic violence; having opportunities for sexual satisfaction and for choice in matters of reproduction
<i>Senses, Imagination, and Thought</i>	Being able to use the senses, to imagine, think, and to reason-and to do these things in a "truly human" way, a way informed and cultivated by an adequate education, including, but by no means limited to, literacy and basic mathematical and scientific training. Being able to use imagination and thought in connection with experiencing and producing works and events of one's own choice, religious, literary, musical, and so forth. Being able to use one's mind in ways protected by guarantees of freedom of expression with respect to both political and artistic speech, and freedom of religious exercise. Being able to have pleasurable experiences and to avoid non-beneficial pain.
<i>Emotions</i>	Being able to have attachments to things and people outside ourselves; to love those who love and care for us, to grieve at their absence; in general, to love, to grieve, to experience longing, gratitude, and justified anger. Not having one's emotional development blighted by fear and anxiety. (Supporting this capability means supporting forms of human association that can be shown to be crucial in their development.)
<i>Practical Reason</i>	Being able to form a conception of the good and to engage in critical reflection about the planning of one's life. (This entails protection for the liberty of conscience and religious observance.)
<i>Affiliation</i>	<p>A. Being able to live with and toward others, to recognise and show concern for other human beings, to engage in various forms of social interaction; to be able to imagine the situation of another. (Protecting this capability means protecting institutions that constitute and nourish such forms of affiliation, and also protecting the freedom of assembly and political speech.)</p> <p>B. Having the social bases of self-respect and non-humiliation; being able to be treated as a dignified being whose worth is equal to that of others. This entails provisions of non-discrimination on the basis of race, sex, sexual orientation, ethnicity, caste, religion, national origin.</p>
<i>Other Species</i>	Being able to live with concern for and in relation to animals, plants, and the world of nature
<i>Play</i>	Being able to laugh, to play, to enjoy recreational activities
<i>Control over One's Environment</i>	<p>A. <i>Political</i>. Being able to participate effectively in political choices that govern one's life; having the right of political participation and protections of free speech and association.</p> <p>B. <i>Material</i>. Being able to hold property (both land and movable goods), and having property rights on an equal basis with others; having the right to seek employment on an equal basis with others; having the freedom from unwarranted search and seizure. In work, being able to work as a human being, exercising practical reason and entering into meaningful relationships of mutual recognition with other workers</p>

Source: Nussbaum (2003)

