

**A MODEL FOR EXPLOITING MOBILE HEALTH TECHNOLOGIES POTENTIAL
TO CURB CHILD MATERNAL MORTALITY**

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ABSTRACT

Zimbabwe has a fairly developed maternal-care delivery system that is served by public and private hospitals at district, provincial and national level. The public health-care system is the largest provider of maternal-care services and caters for the majority of the population but this is done in a resource-restricted context, typical of a developing context. In this context, this research sought to establish the potential of Mobile Health Technologies in Zimbabwe's maternal health sector using Parirenyatwa and Harare hospitals as case studies. The reviewed body of knowledge, which was largely a comparative assessment of mHealth technology adoption in developing countries, indicated that the full adoption of the prevailing eHealth strategy in Zimbabwe remains hamstrung by the slow pace of policy implementation. This is a qualitative study and data was collected with unstructured interviews. Purposive and snowball sampling were used to recruit the participants. The gathered data was analysed through content and thematic analysis. Four broad themes emerged from the primary data collected during the interviews and these include: trends in information dissemination in Zimbabwe's Public Health System; information needs for expectant women and midwives; the prevalence of ICT use in Zimbabwe's Public Health System, and mobile technology use in the maternal health sector in Zimbabwe. The research was able to establish that while there is a high proliferation of smartphone use among most expectant women, this has not translated into their use for maternal information-related purposes. Furthermore, the situation is not helped by the over-emphasis on internal ICT adoption by health centers rather than a patient-centric approach to ICT use. A limitation for this study was its focus on two hospitals which means its findings cannot be taken as a conclusive reflection of Zimbabwe's entire maternal health sector. The research was able to conclude that hospitals need to become perpetual learning organizations on mHealth technology use.

Key Concepts

Maternal health-care; Health-care system ; Antenatal care , Pregnancy; Childbirth; mHealth; mHealth potential; mHealth types; health service delivery; mHealth benefits; mHealth challenges.

DECLARATION

I, Collen Paul Mupandasekwa, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification.

Signature of researcher Date 2018

DEDICATION

This study has become a success because of my supporting family and friends to whom I have dedicated this study to my late mum (Mrs S. Mupandasekwa) who has always inspired me always telling me that the finish line of one race is the beginning of a new one. You have been the pillar of strength in your absence.

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TABLE OF CONTENTS

ABBREVIATIONS

| | |
|---------|---|
| ANC | Ante-Natal Care |
| HCH | Harare Central Hospital |
| HIT | Health Information Technology |
| ICT | Information and Communication Technologies |
| ITU | International Telecommunications Union |
| MCR | Maternal Case Record |
| MHR | Maternal Health Record |
| MMR | Maternal Mortality Rate |
| MDG | Millennium Development Goals |
| MOHCW | Ministry of Health and Child Welfare |
| MOU | Midwifery Obstetric Unit |
| MHealth | Mobile Health |
| MRCZ | Medical Research Council of Zimbabwe |
| NGO | Non- Governmental Organization |
| PGH | Parirenyatwa Group of Hospitals |
| POTRAZ | Postal and Telecommunications Regulatory Authority of Zim |
| SIM | Subscriber Identity Module |
| SMS | Short Message Service |
| UN | United Nations |
| WHO | World Health Organization |
| ZDHS | Zimbabwe Demographic Health Survey |

CHAPTER 1: INTRODUCTION

1.1 Introduction

In recent years, tremendous developments in the integration of ICTs for the healthcare sector of Zimbabwe has been seen leading to efforts being made to adopt Electronic-health as well as developments in mobile health facilities (mHealth) as evidenced by health information system national strategy of 2009 – 2014 which was later refined for the period of 2012 - 2017. In line with the strategy, according to UNDP in 2016 breakthroughs had been made in the adoption of electronic patient management system (EPMS). Using mobile Information Communication Technologies for modelling solutions (whether in business or for healthcare purposes) is now a mainstream practice. It has been noted that various NGOs like Care international in conjunction with World Health Organization (WHO) investing in driving electronic healthcare for Zimbabweans encompassing mHealth within. First Mutual in June 2017 launched their first mobile health application; these moves are in the effort to improve the availability and accessibility of healthcare facilities for Zimbabweans using ICTs, *Newsday* (2017). This development has increased the need for health care institutions to make use of ICTs's potential so as to improve the delivery service to the public. Maternal care institutions are a part and parcel of this move; they have been indirectly provoked to also make use of the potential of mHealth such that the quality of service delivery can be improved, and wider access to maternal care in Zimbabwe can be attained National Child survival strategy (2016).

Maternal Care institutions across the globe are on the look for enhanced ways to improve the service delivery to aspiring mothers so as to reduce maternal mortality rates (Mlitwa, 2011). Institutions are incorporating different types of technologies to save lives during pregnancy and after pregnancy termination thereof (Gutlig, 2010; Middlehurst, 2013). The Zimbabwean Healthcare department has spear-headed the development and adoption of ICTs with the aim of improving delivery of service in a manner that is cost effective which will satisfy both patients at large (Ovum survey 2016). This has changed their operations to being more technology oriented though at a lower spectrum; hence the purpose of this research is to develop a model for exploiting mhealth technologies potential to curb child maternal mortality. In this chapter the background of the study, problem statement, research questions, research objectives, framework used for the research, contribution of study, justification and rationale of the study as well as the research methodology will be discussed in detail.

1.2 Background of the Study

Political and economic crisis of Zimbabwe in 2007 gave birth to a massive exodus of the human capital of the land; health sector of the nation was not left untouched also by the brain drain (Vuuren2012). The maternal mortality problem remains an issue under the international radar concern due to the number of women's lives that are lost from avoidable causes, particularly in developing countries (Prata, Weidert, Fraser, and Gessesew 2013). Women on the move, migration, care work and health (2015), the health of women and children is an important aspect in relation to the status quo of the socio-economic status of a country thus it should always be upheld.

Pregnant women in Zimbabwe are at a risk of dying during the course of pregnancy and birth of a child more so in rural areas of Zimbabwe. The independent (2016) indicated that there was a shortage of specialised healthcare professionals. The World Health Organization (WHO, 2006) evidenced that on top of having the lowest number of specialised medical professionals it also is affected by brain drain where specialised care givers easily exits the country for greener pastures, there are women and children who are left without proper health-care. In particular, expectant women have remained vulnerable (Cook & Kalu, 2008) the majority therefore being women in the rural areas. Consequently, there has been a rise in child and maternal mortality rates.

National Child survival strategy (2016) by the ministry of health in association with UNICEF it was reported that the perinatal mortality rate is 29 per 1,000 live births and it is on a rise. Furthermore, the mortality rate in Zimbabwe is one of the highest in the world, with maternal death rate exceeding 960 per 100 000 live births (UNDP, 2012). This is three times more than 287 women per 100,000 live births globally (WHO, 2014). The major causes however of maternal mortality that have been seen in healthcare facilities can be prevented if provision for access good healthcare is availed.

It is in this vein that the author found it compelling for women of Zimbabwe to gain access to better health services through exploiting the potential of mHealth technologies. Studies done identified quite a number of causes for maternal mortality in Zimbabwe (Ronsmans, Graham and Lancet, 2013). Maternal Mortality in Zimbabwe (2014) managed to isolate the direct reasons which led to maternal mortality in Zimbabwe as attributed to the delays namely:

- 1) Procrastination in seeking medical attention,

- 2) The delay to get to a healthcare facility due to long distance, transportation and infrastructure
- 3) The delay to be attended to by a medical professional due to inadequate staffing, training, equipment etc.

From the three delays prescribed above, previous studies also have pointed out the potential of using technology citing the advantages that technology bring about if incorporated in the healthcare sector. With that in mind a guide and blueprint to exploit the technologies cited in previous researches is what this research aims to provide such that technological benefits can be reaped thereof by the pregnant and expecting mothers of Zimbabwe so as to control these challenges being faced in maternal care.

According to While and Dewsbury (2009), the use of Information Communication Technologies (ICT) is one of the ranges of potential solutions to health-care challenges. Communication via mHealth applications and technologies can be used in a facility with a shortage of resources, especially when it comes to monitoring patients. Free et al. (2013), defines mHealth as using mobile computing and technologies for communication in healthcare facilitation and public health. Thus, mHealth technology encompasses portable hardware devices that can be used on the go (for example cell phones, digital pens or other hand held gadgets) including the software applications as well as wireless networks that enable the transmission, storage and extraction of electronic data (The Rockefeller Foundation, 2010).

mHealth proves useful to healthcare givers who could require Information and Communication Technologies (ICTs) that provide access to data, resources and people where and when they can improve work. In this regard, Broderick et al. (2014) points out that as mobile technologies become more universal and standardised; mHealth applications provides a means by which health and wellness can be improved. Mobile devices are now more available to people who are in need of healthcare services can be used as a real time information conduit to better patient care (Vardoulakis et al. 2012). This study therefore seeks to provide guides on ways by which these technologies can be used to exploit the potential underlying using such technologies in maternal care centres of Zimbabwe.

1.3 Research Problem/Statement of the Problem

Summarizing section 1.2, the problem that this research aims to address is that mHealth technologies that have been developed so as to improve maternal healthcare but have not been fully exploited in Zimbabwe despite efforts being made to show the potential that underlies their use. The problem of mortality rate of women and children in maternal health is too high in countries such as Zimbabwe (WHO, 2015). Maternal-care services could be facilitated by ICT to improve service delivery (Maumbe, 2009) but in developing contexts there is a paucity of information about the extent that ICT is utilised in maternal health-care service delivery, the potential of mobile technologies in maternal health-care services in a developing context versus the use in developed context is not sufficiently explored (Banchani & Tenkorang, 2014). The problem statement derived from the above background is that despite mHealth technologies being developed and their potential being indicated also by other scholars, the drive and guide for their actual use has not been made.

1.4 Research Questions

On the basis of the problem statement and the gap to be filled, the following sub-sections show the Questions upon which the research will be based:

1.4.1 Main Research Question

How can a model to exploit the potential of mHealth in improving maternal care services in a developing context be developed?

1.4.2 Sub Research Questions

- What factors influence maternal health-care service provision in a developing context and how can mhealth solve the negative factors?
- How can mhealth aid service delivery to pregnant women by healthcare professionals on pressure points of maternal care per say?
- How can the different aspects of the maternal health-care service path be improved with the use of mobile technology
- What are the issues contributing to the low adoption of mHealth in maternal health service provision?

1.5 Research Objectives

To answer the aforementioned research questions, the research objectives were formulated as Presented in sections 1.5.1 and 1.5.2 respectively

1.5.1 Main Objective

To develop a model to exploit the potential of mHealth technology in maternal care services of Zimbabwe

1.5.2 Sub-Objectives:

- To identify the major factors that influence maternal healthcare service provision and ways by which mHealth can fill gaps identified.
- To device methods and mechanisms by which mHealth technologies can improve service delivery to pregnant women by healthcare professionals
- To gain an insight as to what has to be done for mHealth technologies to be used at a maximum level by pregnant women across Zimbabwe.
- Identify issues surrounding the low adoption of mHealth technologies in maternal healthcare service delivery

1.6 Theoretical Framework

A theoretical framework is a conceptual model that establishes a sense of structure that guides a research as defined by Babbie (2010). It provides the background that supports a research under study and offers justification for study of a particular research problem. The theoretical framework includes the variables which a researcher intends to measure and establish the relationships that are sought to be understood. It also is a presentation of a theory that explains a particular problem.

This research is comprised of technological factors which are the ICTs in use or usable by the maternal sector as well as the organization which are the hospitals which provide the maternal services together with the environment which the earlier mentioned components operate in. As such the Technology Organization and Environment context (TOE) framework was chosen by the researcher to guide the research.

1.6.1 Technology, organization, and environment context

The TOE framework was developed in 1990 (Tornatzky and Fleischer 1990). It identifies 3 aspects of associate degree enterprise's context that influence the method which it uses to adopt and implement a technological innovation in relation to the technological context, organizational context, and environmental context:

- Technological context gives meaning to technologies relevant to the firm both from within the organization and also external to the organisation. This takes into consideration current practices and resources internal to the firm (Starbuck 1976), furthermore a set of obtainable technologies that are external to the firm (Thompson, Khandwalla, Hage (1980). This was discussed in-depth in chapter 2 where critical examination of the mobile technologies and electronic health systems in developing countries and Zimbabwe was done.
- Organization context refers to descriptive measures regarding the organization like scope, size, and management structure. In line with this research two hospitals were used by the researcher namely Parirenyatwa and Harare hospital. From these two a basic understanding of how they operated was gained by the researcher and also finer details were discussed in chapters to follow.
- Environmental context is that space in which a firm performs its operations and business—its business, competitors, and contracts with the government (Tornatzky and Fleischer 1990). Technology, organization, and Environment framework (Tornatzky and Fleischer 1990). As such the operating environment within which the research was conducted is also discussed in depth in chapter 2. Focus was given to the maternal services in Zimbabwe.

The TOE framework as originally conferred, and later incorporated in IT adoption studies, gives a helpful analytical framework which may be used for finding out the adoption and assimilation of various kinds of IT innovation. The TOE framework includes a solid theoretical basis, consistent empirical support, and also the potential of application to Information Systems innovation domains, although variance among the specific factors known in the three contexts can be experienced across different studies. This framework is in line with the DOI theory, whereby Rogers (1995) stressed individual characteristics, both the inner and external characteristics of the organization, as spear-headers for innovation in an organization. These are similar to the technology and organization context of the TOE

framework; however the TOE framework conjointly includes a new and vital element, the environmental context. The environmental context presents both positive and negative implications for technological innovation. The TOE framework makes Rogers' innovation diffusion theory a better means by which intrafirm innovation diffusion can be explained (Hsu et al. 2006).

Studies which have made use of the TOE framework include the EDI, (Kuan and Chau 2001), Open systems (Chau and Tam 1997) ;website (Oliveira and Martins 2008); e-commerce (Liu 2008, Martins and Oliveira 2009, Oliveira and Martins 2009); enterprise resource planning (ERP) (Pan and Jang 2008); business to business (B2B) e-commerce (Teo et al. 2006); e-business (Zhu et al. 2003, Zhu and Kraemer 2005, Zhu et al. 2006b, Lin and Lin 2008, Oliveira and Martins 2010a); knowledge management systems (KMS) (Lee et al.2009).

The variables that TOE focuses on are technology, organization and environment. In this research the technology aspect will be focusing on mHealth technology and its perceived direct and indirect benefits. On organization variable, the research will be focusing medical centres which avail assistance and services to women seeking assistance and perceived financial cost as well perceived technical competence. On the environmental aspect of it the research will look at perceived pressure in the health care sector and pressure on the government and also how the Zimbabwean populace dim it fit to be using mHealth technology for better healthcare.

1.7 Contribution of Study

While previous studies that have been conducted on issues relating to e-health and mHealth technologies have highlighted potential of these technologies, they fail to provide a solid basis by which mHealth can be adopted for use by people directly affected by such issues. This research seeks to bring the theory into practice by availing a reference tool that will aid in improving maternal care services for women in Zimbabwe by exploiting the potential of mHealth technologies.

1.8 Justification/Rationale

Studies have shown that technological advancements and innovation play a pivotal role in speeding up processes that are done on a day to day basis. The current generation in which we live have majority of people who are well knowledgeable with the technologies and commonly known as digital age (Prensky, 2011) have to a greater extent not known a world

without internet. Such people can cope easily with using technology (mHealth) as a medium to deliver better medical services for pregnant women.

This study is cognisant of the fact that the health sector makes use of many ICT systems varying from finance systems, Human Resources systems and electronic mail systems. mHealth technologies are only a small portion of ICT systems as a whole. In addition it will focus on mHealth adoption in maternal care only, isolating all other systems used in maternal care or health care sector as a whole so as to narrow down the scope of research and derive accurate data as well as draw accurate conclusions. Researches have been done outlining the perceived benefits of using such technologies for use by the maternal sector of the healthcare; this study will therefore provide guidelines so as to exploit those benefits in actual fact.

Adopting mHealth technologies and actually using them will bring a lot of advantages to both the patients and the health practitioners. The next subsection focuses on the research methodology which shows a blueprint of the entire research process.

1.9 Research Methodology

Research methodology as state by (Kirk and Miller, 2006) refers to the specific procedures or techniques used to identify, select, process, and analyse information about a topic. A research methodology allows for critical evaluation of a study's overall validity and reliability. The methodology answers two main questions:

- How was the data collected or generated?
- How was it analysed?

The above questions that a research methodology seeks to answer are discussed further in chapter 3. As a part of the research, the researcher upon identifying the domain in which the research as to be rooted then had to sought for background information which was pertinent to the topic under research. Furthermore the researcher then constructed data collection instruments to collect data which was analysed thereafter and recommendations were made thereafter.

1.9.1 Research design

Manheim (2011) alludes that a research design can be identified as the detailed plan of how the research will be conducted. A good research design will not only anticipate and specify the seemingly countless decisions connected with planning and carrying out data collection, processing and analysis, but will also present a logical basis for these decisions. Academic

research is guided by a number of paradigms. A paradigm is basically a “worldview, a complete framework of beliefs, values and methods within which research takes place” (Voce, 2004). It also defines for the researcher what the study is about, and the acceptable range of a valid research, as such the researcher utilized the research onion developed by Saunders in 2007 for the purposes of developing a research strategy.

Research onion is described by Bryman, A. (2012) as a framework which illustrates the stages that must be covered when developing a research strategy. When viewed from the outside, each layer of the onion describes a more detailed stage of the research process (Saunders et al., 2007). The research onion provides an effective progression through which a research methodology can be designed. Its usefulness lies in its adaptability for almost any type of research methodology and can be used in a variety of contexts. In-depth discussion as to how the research onion was utilized by the researcher during the research is available in chapter 3.

This study focused on exploring the potential of mHealth applications and technologies in maternal care in Zimbabwe using utilizing the research onion paradigm for research purposes.

1.9.1.1 Cross-Sectional Research

This type of study seeks to extract information different groups of people who have different variable of interest but also bear other common characteristics like socioeconomic status, educational background, and ethnicity Manheim (1977). This research design hence will assist getting accurate results from people coming from different backgrounds and aid in the research. This study focused on providing means by which the potential of mHealth technology can be exploited.

1.9.1.2 Research Approaches

This study employed qualitative research approach. Based on data that was collected from the study, there is a deduction to establish the issues relating to why mHealth potential has not been adopted and exploited in Zimbabwe and thereby come up with ways which promote and guide its use.

1.9.2 Study Site

Research was conducted in the medical centres in Zimbabwe particularly those that offer maternal care of will be of paramount importance, both centres in the rural areas and urban areas will be investigated.

1.9.2.1 Target Population

Expecting mothers across all age groups will be a basis by which this research will be based. Medical professionals also in different medical centres is a source from which the needed data will be derived.

1.9.3 Sampling strategies

The qualitative approach is drawn from the constructivist paradigm (Bryman & Allen, 2011) which requires the researcher to avoid imposing their own perception of the meaning of social phenomena upon the respondent (Banister et al., 2011). The aim being investigating how the respondent interprets their own reality (Bryman & Allen, 2011).It presents the challenge of creating a methodology that is framed by the respondent rather than by the researcher. An effective means by which to do this is through interviews, or texts, where the response to a question can be open (Feilzer, 2010).

To ensure a high degree of data quality a sampling strategy that was used for the research is called Stratified Random Sampling which according to (Feilzer, 2010) makes sure that a high degree of representativeness of all the strata or layers in the population is attained. It is a preferred means of sampling since the research contains different prospecting mothers coming from different backgrounds. Thus it is a means by which accurate data can be gathered from different angles.

1.9.4 Data collection methods

In order to collect relevant data and obtain deep insights into the usability of mHealth, suitable data collection methods were used. Literature analysis, interviews and observations methodologies were also used. Literature helped to determine current practices and processes that happen in health-care when patients visit; whilst interviews proved to be useful on obtaining information from the expecting mothers as well as medical professionals. Lastly

observations assisted the researcher in gaining an insight on the unsaid state of affairs within the maternal care health sector.

1.9.5 Data analysis

A qualitative research is defined by (Weber, 1990). as a primarily exploratory research. It is used to gain an understanding of underlying reasons, opinions, and motivations. It provides insights into the problem or helps to develop ideas or hypotheses for potential quantitative research. Qualitative Research is also used to uncover trends in thought and opinions, and dive deeper into the problem. Furthermore it is defined by (Stake, 1995) as an iterative and reflexive process which begins as data is being put together rather than after data collection has been completed. Due to the fact that data is descriptive and explanatory (as participants would explain their experiences to the researcher) as opposed to being statistical, this research is mainly qualitative.

Content analysis is an appropriate technique that will be used in the study. Content analysis is defined as a systematic, re-creatable technique for compressing many textual words into fewer categories based on rules of coding (Weber, 1990). It is a method by which summarising any form of content can be achieved through counting various aspects of the content. This will then enable a more objective evaluation as opposed to comparing content based on the impressions of a listener.

Thematic analysis is a method which is going to be used in this study for data analysis. Thematic analysis is defined as a qualitative research method that is used for description and coding data collection from research participants (Fereday & MuirCohrane, 2006).

1.10 Ethical Consideration

Burns and Grove (2003:85) stated that ethics in research focus on protecting the rights of the subjects of the research and also others in the research setting. The study will not be involving unethical behaviour. Confidentiality will be assured and no names, addresses or patient numbers will be recorded. Participants are free to refuse to participate if they do not want to. All interviews will be carried out in a sensitive manner to ensure that the dignity of participants is respected. Upon agreement to take part in the study, human participants are to be informed that since this is a non-experimental research; there are no potential risks to them. The researcher will ask participants to sign consent forms.

1.11 Conclusion

mHealth is a field that is growing and is being implemented in some areas of the health domain in some countries. The current use and potential of mHealth in Zimbabwe was researched. This chapter defined mHealth, the problem statement, aim and significance of the study were stated. The key concepts were defined and the research design was discussed in brief. Data collection and analysis was introduced and the reliability and validity of the research instrument as well as ethics and research scope were briefly summarized. Chapter 2 will discuss the literature review in the context of mHealth.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The concepts upon which the research is rooted have been identified and they are discussed in this section using literature gathered from different sources. The keywords which are relevant to this research were used to identify the relevant material for use. Publications with material that seemingly were helpful for the research were obtained from scholarly sites like google scholar. Issues surrounding mHealth and maternal mortality were deduced from reference material and text applicable to the topic. Effort was invested to try and locate recent information to give a reflection of current state of affairs. The different important aspects noted from the literature were grouped into sections that are discussed below.

(Zheng, 2015) stipulates that ICT development in health-care is an important research area with multilayer complexity, as it involves human, social and political concerns. In this section a collective view of material relating to maternal health and ICTs is given on broader terms i.e globally to a local point paying particular attention to Zimbabwe's maternal sector and other sub-Saharan countries. Different aspects like maternal health on a global scale, local scale and developing countries are also discussed in this chapter. Healthcare services and maternal health care services also in Zimbabwe are looked into. Technological components also of health sector in Zimbabwe as well as drawbacks of their full utilizations are discussed in this section of the research study.

2.2 Health-care Services

Health care delivery has been predominantly filled with faced with challenges and problems, especially in the poor and developing countries (BMJ 2012). This is a result of growing populations and the ever rising healthcare cost against the availability of resources as the (Global health-care Outlook, 2016) stated. To combat the challenges faced by the healthcare services states have made innovations and interventions which include making investments in Information and Communication technologies to improve efficiency, for the purposes of supporting decisions and making personalized medicine, also for empowering patients as well as improvement of remote health monitoring (Santana et al.,2009). As such countries in the developed world has made progress of note being the United States of America spending

around 19 billion USD to aid in incorporating ICTs in healthcare sector (European Commission, 2010).

2.3 Maternal Health-Care

Human Rights Watch report (2015) declared that improving maternal health has continuously been a problem of concern. Period from 1990 to 2015, the world maternal mortality quantitative relation (MMR) dropped by a quarter mile, from 385 to 216 maternal deaths per one 100,000 live births. Despite positive strides taken, the world still fell way wanting on the MDG target of a 75% reduction within the world maternal mortality quantitative relation by 2015. More so, massive inequalities in different geographical regions persist. The Sub-Saharan region in Africa has the largest maternal mortality ratio at 546 maternal deaths per 100,000 births given whereas typically maternal mortality in regions that are developed is simply twelve maternal deaths per 100,000 births given, thus forth maternal deaths are predominant in developing countries This issue of maternal mortality still is a priority to make sure healthy lives for expecting mothers and promote well-being for all at ages in the context of goal 3 (WHO 2015). The target on maternal mortality is to scale back it to a figure of less seventy deaths per one thousand live births by 2030 (WHO 2015).

In the spectrum of humanity, one of the contributions to death and disability among women is child bearing and pregnancy. Most of maternal deaths are due to infection, haemorrhage, unsafe abortion, and toxemia (high blood pressure resulting in seizures), as well as from complications of health state that is worsened during pregnancy. From the aforementioned scenarios, inaccessible, unaffordable, unavailable or poor quality care is basically accountable. Deaths that are a result of maternal issues are harmful to development of our society and well-being. About one million kids are left without mothers every year. Majority of these kids tend to die between 1-2 years of their mothers' death Hunt & Bueno, (2012).

Women do not need to lose their lives in giving birth, they need to be given data and support which will be helpful to deal with their reproduction health desires, help the expecting mother through the pregnancy period, and look after her and the new-born thereafter well into childhood. The overwhelming majority of these maternal deaths may well be reduced/prevented if the females could get access to quality birth control services; skilled professionals care throughout pregnancy, parturition ; or post-abortion care and wherever permissible, safe abortion services. Magnified attention for girls living in conflict set-ups, or

under humanitarian crisis is required because an operational health system with skilled personnel is vital to saving these women's lives.

2.3.1 Maternal Health-care in Developing Countries

In countries that are developed, women that are expecting leave for to seek medical attention once it's time to give birth, and bid farewell when preparing themselves birth and the happiness of a baby on its way. While this is the case in nations with top quality maternal services these fast sensible-byes could bear the meaning of good luck and will re-unite soon; on the other end of the globe, the image is contrary. Rather than looking forward to a joyous event, families on the other end of the globe have sensible reason for concern that they will possibly not come back. For them it's a sincere good-bye because the mother are separated from their loved ones in order to deliver on the ground, or they hardly find means by which they can get to a poorly equipped health facility which means that it is, a true farewell; a proper separation to acknowledge the probability that they will not come back from the path which they have embarked on. A popular phrase in sections of the continent is that a pregnant girl has one foot within the grave.

These mothers' fears are real. For every minute of every day, every day of every year, year in and year out, somewhere in the world a woman loses her life of complications emanating from pregnancy or childrearing. Over 600,000 women needlessly die each year (Huda et al, 2012). The larger population of these women lose their lives without skilled care, probably lying on a dirt-ridden floor getting assistance only from the women of their families or unskilled birth attendants using traditional methods or harmful practices. They lose lives in pain. It is assumed that at least 80% of the daily tolls of 1600 maternal and 5000 new-born deaths are a result of complications of pregnancy which can be preventable or treatable at a minimum cost, even in resource poor settings (WHO 2015).

Dying is not the only potential catastrophe these expecting women are presented with. The World Health Organization (WHO) estimated, that globally, that over 300 million women live with disabling long-term complications as a result of complications emanating from pregnancy and or childbirth. Of these, 20 million new cases arising every year. 75 percent of those conditions include chronic anaemia, obstetric fistulae with urinary and/or faecal incontinence, foot drop or palsy, uterine prolapse or pelvic inflammatory disease. More than two million young women are living with the consequences of untreated obstetric fistulae.

Majority of the women are then isolated and rejected or even ill-treated by their husbands, communities and families. It is nearly impossible to put a measurement of the impact of the psychological consequences of these problems on so many of the world's mothers.

Babies are not isolated from these issues, they suffer as well. Maternal mortality and morbidity bear a direct impact on the health and wellbeing and livelihood of the baby. About 98% of the nearly six million stillbirths or deaths of babies in the first week of life occur in developing countries (BMJ, 2011). Majority of the babies will die because of maternal complications, one third being a result of intrapartum complications leading to birth asphyxia. Babies who survive the death of their mother rarely get to their one year's birthday and millions of older, motherless, children are faced with uncertain futures. As they may be orphaned, predominantly in countries where HIV prevalence is high, or they can be taken in by relatives who already face difficulties in providing for their own families as a result these kids are put at the end of the already inadequate food queue. In a nutshell, children under five face a double amount of risk if their mother dies during childbirth and it is higher for the girl-child (BMJ, 2011).

Globally, about 63% of women receive support and care during birth from a skilled health worker. While such coverage is almost universal in developed countries, in those with less resources the picture is bleak. In Africa and Asia only 47% and 61% of mothers, respectively, give birth with a skilled carer to hand and in some African countries the proportion is as low as 34%.⁹ this means 600 million mothers across the globe give birth without access to skilled care every year (Gamble, 2013).

The conditions for under which women are losing their lives during pregnancy and after the birth of a child are not hard to manage. Pregnant women die due to the fact that they won't be receiving the medi-care that they need, for instance access to basic or emergency maternity services as well as a skilled attendant during childbirth WHO (2013). Pregnant women die because they do not have the financial resources necessary for the health care facilities they require, at times they will be malnourished, lack contraception, have little or no pregnancy education, have no control over their lives and have to defer to the male or elderly women decision makers in their families and communities, have no voice and live in societies which, to date, have not invested in maternal health. In many cases, the failure of support for

pregnant women by their families, partners or government reflects the lack of societal value placed on women's lives.

2.3.2 Why Mothers die During Child Bearing

2.3.2.1 Direct causes

Direct deaths are deaths which are a result of complications that can only arise because of pregnancy, for example eclampsia, haemorrhage, obstructed labour or sepsis.

2.3.2.2 Abortion

An estimate of women's population totalling to 46 million face an unwanted pregnancy annually. Of the 46 million, 16 to 20 million women are at a risk of doing an unsafe abortion as a result. An estimate of 69000 women annually will die while others have to live with physical and psychological scars which may include infertility, infections or genital tract trauma and chronic pelvic pain. Unsafe abortion is more common in younger women, as majority of these abortions occur among females between 25 and 30 years of age. About 2.5 million abortions in developing countries are among adolescent girls or young women of less than 20 years of age.

A rough estimate of 100,000 maternal deaths a year could be avoided each year if women who do not wish to become pregnant had access to, and used, effective contraception. Furthermore, the UK Department for International Development in 2015 estimated that increasing the minimum age of marriage and first birth, preventing unwanted pregnancy and eradicating unsafe abortion will prevent one-third of maternal deaths, and birth spacing and prevention of pregnancy in very young women may reduce neonatal mortality by one quarter.

2.3.2.3 Indirect causes

Despite deaths from medical conditions aggravated by pregnancy, indirect causes are responsible for some 20% of the maternal deaths around the globe; in countries that are developed they generally outnumber deaths from direct causes. In developing countries, at least, the most common indirect conditions leading to death or long-term complications are related to infectious or transmissible diseases such as HIV/AIDS, malaria, hepatitis and tuberculosis.

Above are some of the reasons which sum up the reasons why lives are lost during pregnancy and child bearing.

2.4 Health-care in Zimbabwe

While Zimbabwe's Ministry of Health and Child Welfare provides strategic and operational directions for Zimbabwe's health sector, the delivery of health services is driven by a wide variety of players who mainly work as autonomous bodies. The implementation of their healthcare programs is governed by the provisions of Primary Health-care (PHC) which incorporate maternal health-care, paediatrics, health outreach activities, dietary advice, disease control, environmental management and drug use (Zimbabwe Ministry of Health and Child Welfare, 2013). Despite the diversified mix of health-care providers, Zimbabwe's public health system remains the foremost provider of health services. In areas where the reach of public health facilities is limited, mission hospitals and non-governmental organizations have moved in to fill the gap. Public health-care is delivered at four levels which are meant to function as a referral chain (Zimbabwe Ministry of Health and Child Welfare, 2013).

- **Entry Level:** This is made up of Rural Health-care centres, Rural Hospitals and Urban Clinics. The services do not require an attending physician;
- **First Referral Level:** This is made up of District Hospitals;
- **Second Referral Level:** This is made up of Provincial and General Hospitals;
- **Third Referral Level:** This level is made up of Central and Special Hospitals.

An independent study done by UNICEF found that, due to declining budgets necessitated by a contracting economy, the quality and quantity of health-care delivery has declined considerably in Zimbabwe. It's a situation that has mostly affected the country's poor, whose level of access has dropped significantly to 40% (UNICEF, 2016).

2.4.1 Challenges in Zimbabwe's Healthcare Services

Decline of the Zimbabwean economy saw a continuous and increasing inflation, deteriorating physical structures. As a result in 2008, the inability of the public sector to deliver basic social services was evident. Since then country has been facing severe human resources capacity constraints in the public sector particularly the more specialized skills, the health sector in particular has been affected by shortages of specialised doctors in their practices.

Filling vacant posts and responding to the needs of the doctors to retain them has been a major challenge. This grave situation reached breaking point recently when the health workers took to the streets their grievances which resulted in very few services being offered in health facilities and in communities. The retention scheme introduced following the industrial action partially resolved the human resources issue, but only for the lower level staff; there is still a shortage of highly technical staff.

2.4.1.1 Socio-cultural issues

There still is a minority group of people who refuse medical treatment or advice, based on their religious or traditional grounds. This particular group of people is an important factor in relation to the identification of the population's health-seeking behaviours. For instance, both tradition and indigenous religions constitutes strong bearing on the child mortality rate in Zimbabwe. Some religious groups do not permit their children to be immunised or their sickness to be treated using modern drugs.

2.4.1.2 Environmental factors

The availability of clean and safe water supply together with good sanitation are major contributing factors to yield positive results in childcare. At the current moment, Zimbabwe is at present not able to provide clean water for all rural and urban areas. Of the Zimbabwean population, over a third still rely on the bush toilet for sanitation (mainly in the rural areas of Zimbabwe), and it is widely understood that diarrhoeal diseases can be exacerbated in environments where sanitation is poor.

2.4.1.2 Health services user fees

It has also been proven that the acute increase in child mortality is linked to the introduction of user fees to access health services for pregnant women.

2.4.1.3 State budget for health

During the decade 2000–2010, state investment in health varied from 4.2% of the state budget in 2001 to 15.3% in 2009. An important commitment would be to keep to the Abuja Recommendation of 15% of the state budget for health. However, this proportion of the national budget falls significantly short of the per capita health cost allowance, which, according to the Ouagadougou Declaration, should be US\$34-US\$40. Currently, Zimbabwe's annual budgetary allowance only stretches to US\$9 per capita.

2.4.2 Access to health-care

In comparative terms, proximity and ease of access to health-care centres by Zimbabweans when viewed in tandem with their African counterparts remains very high. An Access to Health-care Services study found that 60% of citizens reside within a 5km radius of the nearest health center, 23% live between 5 – 10 km and 17% are located within a 10km radius (NCSS,2010-2015).In an effort to contain declining budgets and escalating costs, Zimbabwe's healthcare providers introduced user fees which further compounded the decline to health-care access by the populace. Since these charges are applied on an ad-hoc basis, this has created more barriers for the society's most vulnerable who now shun primary health-care because of the costs involved (Health Transition Fund, 2011). The government has, in times past, made it its policy to provide free health services to vulnerable groups such as pregnant women, lactating women, children below the age of 5 and senior citizens over the age of 60. Over time, and without government support, it has proven difficult to continue down this path forcing health centres to institute user fees to help them remain operational. The downside of this approach, which has seen costs of giving birth at municipal or government health centres ranging between US\$3 - \$50, has been the rise in home births and consequently high mortality.

2.5 Health Information Technology in Zimbabwe

Health Information Technology (HIT) is defined by the Office of the National Coordinator as the synchronized use of computer hardware and software to store, retrieve and share healthcare knowledge for decision making purposes (ONC 2014). It therefore has the potential to facilitate better health-care service provision. Specialists believe that mobile phones can transform the health system in the developing world (Vital Wave Consulting, 2009). This principle has led to the launch of several HITs projects in developing countries. Technology now has a huge influence on people's lives, which makes people more dependent on it. The health sector has always relied on technologies. WHO (2013) has discovered that HITs now account for the bulk of categories used to diagnose and to treat diseases. Their efficacy has seen them become the backbone in health-care delivery. Given the right policies, organisation, resources and institutions, HITs can be powerful tools in the hands of those working to improve health (Daly, 2013). Specialists in the health sector believe that mobile phones can change the health system in the developing world (Vital Wave Consulting, 2011). In developing countries, a lot of Information and Communication Technologies have been

launched due to this principle. Examples include Mom Connect in South Africa (Western Cape Government, 2014), MoTech in Ghana, Medic mobile in Malawi (Mahmud, Rodriguez & Nesbit, 2010) and Rapid SMS in Rwanda. According to WHO, the use of Health Information Technology enables the reaching of desired outcomes such as:

- Enhanced and informed decision making by health workers
- Provision of high quality and safe care by hospitals
- Making of informed choices about people's own health
- Provides a basis by which the governments can become more responsive to health needs
- Both policy makers and general public becoming informed / aware of health risks
- People getting better and quicker access to the knowledge and information that is useful for better health (Dzenowagis, 2015).

Health information technologies have great potential to promote health through health information services to promote healthier lifestyles and prevention of diseases and also to support health-care services around the world. Government agencies, health practitioners, private sectors, academia and NGOs across the world have recognized the advent of HIT in health-care as a breakthrough in quality health delivery. Developed and developing countries have perceived HIT adoption as the main driving force in the unfolding health-care reforms (Gladwin, Dixon & Wilson, 2003:214; Chen & Kaufman 2010). The importance of using ICTs is now being known by developing countries to stimulate sustainable development as well as the creation of an information society (Crede & Massell, 2010). A few authors explain that health professionals need to maximize the potential benefits offered by HITs as a means of improving public access to health-care information (While & Dewsbury, 2011). For the efficient administration of an organization and the delivery of health-care services, HITs are an essential tool (Jimoh et al 2013;). In order for the managers to operate more effectively and efficiently, to minimize costs of health-care delivery and improve the quality of services, they are seeking opportunities in the ICT field (Jimoh et al., 2013). An inference can thus be made from the foregoing that HIT has become a critical component in the provision of knowledge management and patient care to fight diseases while encouraging interconnectedness among health-care professionals (Van Heerden, Tomlinson & Swartz, 2012).

2.6 Health Records

In the Morden health-care setting records are still being handwritten however the patient records and data is increasingly being created, maintained and stored in electronic formats which can take many different forms. A health record is defined as a record made by a healthcare professional at a time when subsequent to a consultation and/or examination or the application of health management. It is comprised of information concerning the health of an identifiable individual recorded by a health-care professional, either personally or at his or her direction (HPCSA, 2016).

2.6.1 Paper Based Health Records

In most developing countries, including Zimbabwe, Paper-Based Health Records (PBHRs) still remain the ‘gold standard’ in the management of health information (Stausberg et al., 2013). While there have been efforts to make Electronic Records Management (ERMs) run parallel with PBHRs, the latter has remained the default information management platform across the various aspects of the health delivery system. PBHR’s distinct disadvantages can be found in the quality and quantity of records under management where coding and classification still remains tedious and time consuming. The amount of time that health professionals spend retrieving patient data from PBHR files is much more than the average time spent on ERM files. Despite these shortcomings, an ERM is usually used together with paper-based records and is usually only a subset of the paper-based record” (Sharma et al., 2016). The advantages that PBHR’s bring to service delivery in the health sector are varied. It has been established that they are a reliable tool to remind health-care professionals on the need to record and report events such as antenatal progress reports and help facilitate communication across the health service delivery chain (Sharma et al., 2016). Zimbabwean health centres have institution specific records management policies in place, they all give preference to PBHR although this is gradually changing with the implementation of the country’s E-health strategy for 2012-2017 (Zimbabwe Ministry of Health, 2014). Perhaps the emphasis placed on PBHRs is driven by industry needs where entities such as health insurance and medical aid companies require paper-based records to do business with potential clients. Relatedly, PPHRs still remain a valid instrument for health statistical surveys due to their efficacy in recording the conditions of patients in real-time. Paper-based Health Records are less structured compared to records contained in an Electronic Records Management System. This helps health practitioner’s to record more information about their

patients unhindered by a controlled structure as can be found in a health database. The consistent use of accurate PBHR can limit the dangers associated with inconsistencies that can be brought by using both the PBHR and ERM records (MoH, 2012). An evaluation study carried out by Zimbabwe's Ministry of Health on the condition of health records across the country's health centers in 2012 revealed that the classification and coding system was still relatively efficient (Zimstats, 2012).

2.6.2 Electronic Health Records

An electronic health record (EHR) is a longitudinal complete health record, under the custodianship of a health-care provider that provides a biographical record detailing a patient's medical history over time. Its individual-specific nature presents opportunities to health-care professionals across various disciplines to appropriately diagnose a patient at any given time (Canada Health Infoway, 2013). Hayrinen, et al (2008) define EHR as a patient's record that is stored in a digital form. Approved users store and share these records based on their access rights. Implementing electronic health records (EHRs) in primary health-care is important, yet it poses many challenges (Gamble, 2013). The growing importance of EHRs in health-care provision cannot be understated. They have revolutionized health-care provision by improving the quality of decision making, knowledge-sharing among professionals and improved access to real-time health-care information (Ebell & Frame, 2011). Also, use of information technology systems has been linked to a decrease in medical errors (Bates, 2010). Using EHRs could improve patients' health outcomes through enhanced disease management and increased levels of preventive care (Bates et al., 2013). Finally, some efficiency can be realized through eliminating routine tasks, such as pulling paper-based charts (Bates et al., 2013). The obvious benefits of EHRs in enhancing patient experience in health-care provision have not seen a corresponding increase in their adoption and use. In fact, the uptake has been limited (Leatt et al., 2014). For example, The Canadian College of Family Physicians was able to ascertain that a limited number of family physicians were using EHRs in their practices (College of Family Physicians of Canada, 2013). Research on the usefulness of EHRs in health-care has focused on practitioners' performance and system productivity but further inquiry needs to be conducted to assess the impact that IT adoption is having on patient experience and healthcare outcomes (Mitchell & Sullivan, 2011). Canada offers a good opportunity for such an inquiry as the use of Electronic Medical Records (EMRs) in primary health-care has taken root. Relatively recently, the tide has begun to shift in the use of EMRs in Canadian primary health-care (Canada Health Infoway, 2013). EMRs

are being promoted as a tool that can assist in improving health-care in Canada (Health Council of Canada 2011). There is some evidence to support the association between EMR use and improved PHC practice (Lau et al., 2014).

2.6.2.1 Policy Models in Electronic Health Records

In trying to achieve privacy and confidentiality protection of data, Terry (2013) suggests that there are six models (Terry, 2013: pg 14) that policymakers use to design policies. The following section will have a look at these models in order to ascertain their ideological bearings.

- Limiting data collection – this model seeks to prohibit the collection of data of a certain type.
- Regulating the disclosure or distribution of collected information – this model seeks to monitor and restrict sharing of information where necessary.
- Breach notification – here whenever a regulation has been violated all stakeholders or parties involved should be notified accordingly.
- Limiting processing of collected data – here policies seek to restrict the use of healthcare data for secondary uses.
- Devaluation of data – this model emphasises the de-identification of data being collected i.e. all elements that can enable the identification of the patient or entity involved should be avoided.
- Data Security – these set of policies seek to ensure that the collected data is only accessed by permitted users.

It is either one or more of these models that are applied in policy design to ensure that privacy and confidentiality metrics are met. Most of them can be said to make data collection and sharing cumbersome and neither of them promotes information access. All have a permeating character of being protective of the data in concern. In the age of big data, such a strong protective nature will have to fade away or be loosened. Terry (2013) however has a different opinion as data protection is concerned. He concludes that the tougher measures on data collection and privacy controls are to be the way forward. If his stance will be adopted by policymakers big data prospects will continue to be greatly hampered (Menius & Rousculp, 2014; Hripcsak et al., 2014; Pasquale, 2013). Commenting on collection based models of regulation, those that prohibit collection; Terry (2013) argues that they will not be sufficient

to address the problem in concern as people will always try to find a loophole in the system to achieve their required outcomes. Identification on its own is becoming difficult as re-identification is becoming easier and easier with time. Also, there can only be a limit to the amount of de-identification that can be done before data becomes useless as Ohm suggests that when data becomes perfectly anonymous its usefulness ceases to exist (Ohm, 2010).

2.6.3 Maternal Health Records

Maternal Health Records, which are a component of patient information systems, provides a data trail that charts the health of an individual to monitor pregnancy development. This is essential to combat complications associated with maternal morbidity and mortality namely infections, high blood pressure and obstructed labour (WHO,2012). According to the New South Wales Provincial Government (2013): the purpose of a Maternal Records is to establish a standard approach to risk management in maternity services; assist health services with timely and effective management of incidents; ensure a consistent and coordinated approach to the identification, notification, investigation and analysis of incidents with appropriate action to all and to allow the lessons learned to be shared.

The Management of Maternal Health Records enables clinicians, managers and policy makers to implement strategies that improve access to and sharing of information. To this end, the significance of maternal health information in Zimbabwe is made evident by the emphasis that is put on having dedicated units that are tasked with keeping maternal records in standalone information management repositories. The World Health Organization posits that ‘the key to effective patient information systems is to retain the link between the individual and the data collected over time and to make that data available to multiple health-care providers when needed’ (WHO, 2012).

2.7 ICTs in HealthCare

With the improvement of ICTs in majority of sectors worldwide, they have been incorporated in several domains and as such healthcare sector also has made use of these ICTs. These ICTs have gained ground in developing countries also. Below are some of the IT services that are incorporated in the health care sectors.

2.7.1 eHealth

Electronic health, rather known as e-Health, continues to be an up-and-coming field such that different explorative studies are still being done in this area. Terms such as e-Health or e-Health or e-Health IS are interchangeably used to describe the systems, which include telehealth, telemedicine, mobile e-Health (m-Health), hospital information systems (HIS), electronic medical records (EMRs), electronic health records (EHR) to mention a few (Mea, 2011; Blaya et al., 2010). The term e-Health only came into use in the year 2000, and definitions of e-Health have varied with respect to its functions, stakeholders, and technology-specificity (Pagliari et al., 2015). According to Eysenbach (2010), e-Health refers to the use of ICT devices and the internet to aid public healthcare, medical informatics and business to render quality services and improve information dissemination. It provides a platform through which electronic media are used to facilitate and enhance quality assurance of the public consumers' healthcare service delivery by providers (Ball & Lillis, 2010). Moreover, with respect to medical informatics, the systems support new methods to create, keep and maintain records for hospitals as well as improve management, accountability and security in processes (Ludwick & Doucette, 2009).

In terms of business, e-health provides the opportunities for different health information technology (HIT) vendors to manufacture information systems (IS) that improve the handling of information by healthcare providers (Middleton, Bloomrosen, Dente, Hashmat, Koppel, Overhage, Payne, Rosenbloom, Weaver & Zhang, 2013). E-Health IS are information technologies that make use of developed software applications to manage, process and use information designed for administrative and clinical support functions to deliver efficient and effective healthcare services (Cline & Luiz, 2013).

However, alternative peer-reviewed scientific research emphasizes specifically on the use of inter-networked digital technologies, principally the internet, therefore distinguishing e-health from plain medical informatics (Blaya et al., 2010). In particular, the World Health Organisation suggests a more encompassing definition of e-Health as: "the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research" (WHO, 2015:pp 109). The WHO definition justifies the scientific investigations done on e-Health IS to include the adoption of technology as a means to extend, assist and to enhance human activities and processes, rather than as a replacement

(Oh et al., 2015). Ultimately, from the WHO definition and literature, information and communication technology (ICT) can be used widely in the healthcare field to support administrative, clinical and educational requirements.

2.7.2 Telehealth

Telehealth encompasses using telecommunication technology as well as virtual technology to avail health care services beyond the boundaries of traditional health-care facilities. Telehealth, requires access only to telecommunications and it is the most basic element of “eHealth,” that makes use of a wider range of ICTs.

Examples of Telehealth include virtual home health care. Under virtual home care patients like the chronically ill or the elderly are able to receive guidance in certain procedures in the comfort of their homes. Telehealth has also enabled health care workers in remote field settings to ascertain guidance from professionals elsewhere for diagnosis, care and referral of patients. Training at times can also be delivered via telehealth schemes or with other related technologies for example eHealth, which makes use of small computers and internet.

Telehealth schemes that are well designed can improve health care services and results, especially for treatment of chronic disease and vulnerable groups. Over and above reducing demands on crowded facilities, they also create cost savings and make the health sector more resilient.

Remote communication and treatment of patients aid in reducing the number of visits for health services, both transport-related emissions and emissions related to operational requirements are also reduced. In addition, fewer space demands can potentially result in smaller health facilities, with concurrent reductions in construction materials, energy and water consumption, waste, and overall environmental impact.

2.7.3 mHealth

mHealth refers to the using of mobile telecommunications and wireless technologies to integrate and develop successful health-care delivery systems (Kahn, Yang & Kahn 2010). The efficacy of mobile technology rests in its ability to enable users to have unhindered access to information thereby enhancing ease of access, networking and knowledge sharing (Kaplan, 2016; Sheng, Nah, & Siau, 2016). The rapid growth of mobile use in developing countries has provided opportunities for policymakers to use this technology in the health

sector to bridge the gap that has been created by the slow progress in ICT adoption (Garai, 2011). Mobile phone penetration, even in the remote parts of the developing world where the majority of the population still lives, has created an avenue through which mobile phones can be used as an ICT tool to improve livelihoods. mHealth has the potential to break down barriers to health-care which has often affected underserved communities in rural areas (Marufu, 2014). One cannot deny the fact that the social dimension of mobile phones presents clear opportunities for improved health-care and the general welfare of communities by improving disease management capabilities. The impact of their use can be universal with United Nations Conference on Trade and Development (UNCTAD) figures suggesting that mobile networks cover more than 90% of the world's population (UNCTAD, 2008). Their hands-free capabilities transcend the infrastructure requirements needed for conventional internet connectivity, a feature that can be configured to optimize the delivery of health services to underserved communities. This explains why there has been a deliberate policy shift by governments in developing countries to prioritize the inclusion of mobile technology to overcome structural challenges hindering access to health-care (Krishna, Boren, & Balas, 2009). A realization has been made that the inclusion of mobile telephony among the ICT tools already in use in the health sector will improve health outcomes by facilitating an improvement in quality and regular care (Klasnja & Pratt, 2012; Noordam, et al, 2011; Tezcan, et al, 2011;). The resource constraints afflicting health systems in developing countries have made mHealth an attractive option to broaden universal health coverage, even to remote rural areas (Krishna Boren, & Balas, 2010;Tezcan et al., 2011. Various studies conducted on medical research think tanks have credited mHealth technologies with the improvement in cost containment measures, efficiency in health-care delivery, real-time health-care information dissemination, the tracking and tracing of diseases (De Tolly et al, 2012; Lim et al, 2011; Chib, et al, 2010). It cannot therefore be denied, as concluded by Hilbert & Lopez (2011) that the incorporation of ICTs in the health sector has led to advances in data collection, disease monitoring and evaluation, in-house information sharing, holistic patient experiences and ease in health-care auxiliary training programmes. Currently, evidence on the importance of mHealth is sparse. As far as mHealth is concerned, past research is marred with arguments and controversies. Furthermore, whether mHealth leads to better overall health outcomes and reduced disease burden remains unclear (Wu, Li & Fu, 2011). For example, Whittaker (2012) conducted a study in the USA with a special focus on important issues facing the implementation of mHealth from the perspective of those within the US health system and those working in mHealth in the United States. The research

inquiry was able to establish that concerns on data security, limited financial resources, unavailability of mHealth technology best practice and the absence of high quality research were some of the issues affecting full mHealth implementation. Although Whittaker (2012) queried the efficacy and cost effectiveness of mHealth application in a Developed country setting, Marshall, Lewis & Whittaker (2013) indicate that the preliminary evaluation results from mHealth applications have demonstrated positive outcomes and cost savings for developing countries. The use of mobile technology for mass communication and disseminating information to the communities seem to have the potential for a wide scale impact in developing countries Thirumurth and Lester (2012) state that mHealth is a fairly new intervention in health systems hence much research is to be done to establish how it can be implemented. Kumar (2013) further recommends that rigorous research is needed to determine the value of mHealth. Specific areas of focus should examine the potential as well as the challenges of using mobile technologies to improve health outcomes. Marufu (2015) studied mHealth in Zimbabwe and found limited evidence-based reporting in the literature. Patients rarely use their cell phones to call doctors during emergencies and this could possibly be contributed to the high cost of smart phones and bandwidth accessibility.

2.8 Ways to Improve healthcare services using mHealth

There are a number of ways by which mHealth can potentially be used to provide health-care services (Kinkade & Verclas, 2012). This however does not simplify the difficulty that often confronts those tasked with implementing mHealth since the system by itself cannot improve health outcomes. That said, the key areas to pay attention to during implementation include:

2.8.1 Refining patient compliance

Sending reminders to patients using voice calling or SMS have the potential to improve adherence. SIMpill, a mobile device that was used in a pilot study in South Africa to gauge patient response to direct reminders, recorded an increase in patient compliance. (Vital Wave Consulting, 2013). SIMpill is a chip enabled medical container that is synchronized with an assigned mobile phone number to notify the patient if he or she happens to skip the assigned dosage intake times. SIMpill allows health professionals to remotely monitor their patient's dosage intake and to take the appropriate steps in cases where a patient deviates from the set times.

2.8.2 Publishing health information among the community

Text message services, voice calling, or e-mails may be used as methods of disseminating health-care information. Primary prevention is key to reducing of disability and diseases, and use of mHealth technology provides an effective channel to fulfil this objective. Michael (2010) stipulates that mobile phones have bridged the digital divide but extreme caution should be exercised by those using this technology to distribute information. Due consideration should be paid to the accuracy of the information, its relevance and currency to the target population. Information dissemination can vary across the board depending on the actors involved in the exchange. Health-care providers and patients may interact amongst themselves or across their specific groups.

2.8.3 Remote diagnosis and support

Medical imaging and the medical diagnostic field stand to benefit from the opportunities presented through remote access in areas where health-care facilities and professionals are scarce (Kahn, Yang & Kahn 2010). Relatedly, collaborative engagement between health professionals on complex cases is also enhanced, leading to faster turnaround times on decisions on whether to refer cases to emergency care. Such progress has lessened the impact of medical staff shortages in developing countries. Despite innovations in telemedicine being increasingly adopted by health systems in developed countries, initiatives have remained in pilot or in informal settings in developing countries. The MDNet Ghana program is one of the successful examples, showing how simple mobile technologies may be used to fill gaps in health-care delivery (Kallander, 2013).

2.8.4 Health records: web-based data entry and disease surveillance

At the most basic level, mHealth has led to improvements in the notification and tracking of diseases. A notable example in this regard has been Medic Mobile's 'Patient View' which has been instrumental in medical mapping. According to patient views nonetheless show that medical applications can be made redundant if they are not embedded within national health databases or electronic patient record systems. Africa has been trying to keep up with assimilating this technology into its health system with remarkable results although a slow pace (WHO, 2014).

2.8.5 Emergency Response

Citizen involvement within the health-care delivery chain can often prove to be a critical factor in emergency situations (Michael, 2010). A notable example in the use of mHealth technologies in emergency response was seen in the aftermath of the 2010 Haitian Earthquake (World Health Organization, 2014). The advantages of mHealth cannot be overstated, simply because it effectively harnesses existing telecommunications infrastructure to provide a health service to remote areas that are often isolated and far away from health-care centres. The proliferation of basic health-care tips which were hitherto unavailable can now be expedited through mobile phones. (Vodafone Group, 2006) evidenced that contact by SMS is capable of increasing patient compliance for treatment regimens combatting diseases such as TB and HIV, both of which require strict adherence for successful outcomes.

2.8.6 Education and health promotion

The predominant mode of communication that has been employed by health practitioners through mHealth technologies has been text messaging, which – by reason of its simplicity, facilitates the distribution of basic health information to specific target groups (Cole-Lewis & Kershaw 2010). In a study that was done on Uganda's 'Text to Change' messaging service by researchers (Jamison, Karlan & Raffler 2013), it was established that developers can make the service more interactive by encouraging users to answer pertinent questions on the information delivered to their mobile devices. Besides text messages, users can also be encouraged to use toll-free numbers to ask questions about their health or get details about their nearest health-care centre for a more proper diagnosis (Vital Wave Consulting, 2009). It therefore goes without saying that both the text messaging and toll-free dialling platforms are cheap and can reach a wide target population in a short space of time. In fact, some scholars are of the view that these two mHealth gateways promote confidentiality as users are able to access information on sensitive topics such as HIV or pregnancy testing (Bakshi et al. 2011).

2.8.7 Remote data collection

The developing world still has vast geographical spaces that are remote and populated with communities that are further away from modern nodes of development. This poses serious challenges for any policy maker collecting data for the purposes of trying to get a clear understanding of the challenges faced by these communities. To overcome this challenge, researchers have started making extensive use of remote data collection (Vital Wave

Consulting 2009). Remote data collection is different from the generic data collection method in that it relies on embedded mobile software to collect data in real-time, a feature that makes it cost-effective and guarantees the accuracy of the data collected. It marks a complete departure from traditional data collection methods where paper based surveys were the norm. Some of the major shortcomings that often bedevilled paper surveys included elements of human error in data entry, the cost of human capital and time constraints (Vital Wave Consulting 2009; Michael 2010). The World Health Organization (2014) posits that the real-time feature of remote data collection allows ‘timely analysis that provides policymakers with accurate, reliable data for reporting and planning’. Perhaps its most notable characteristic, and critically so, is the speed of access that the technologies used avail to other researchers thereby reducing chances of duplication in research (Mukudu & Belle 2012). Various technologies for remote data collection are available on the market, both in open source and commercial formats. However, regardless of where one sources them from, it is of paramount importance that the chosen technology is able to have an acceptable level of compatibility with the conditions of the area under study. This might explain why EpiSurveyor has been an application of choice in most mobile phone surveys in Africa. According to Aanensen et al. (2009), ‘it creates easy-to-use surveys on mobiles or PDAs’. The programmes’ open source nature reduces costs and enables health professionals to customize and design their own health surveys. As seen with the above examples the available literature is littered with examples of mHealth initiatives that have been instrumental in facilitating health interventions in under-served communities (Vital Wave Consulting 2009; Michael 2010). These interventions range from capacitating health technicians who carry out community outreach campaigns to community members who require information on basic health-care questions. For the former, a good example will be the Ethiopian programme where there is a deliberate plan to capacitate health extension workers through mobile devices and help them monitor health trends in the areas where they operate (Aanensen et al. ,2009). In Kenya, a country which serves as classic illustration of community assistance through mHealth technologies, users benefit from mobile technology that helps expedite the process of registering births and deaths through an integrated system that is linked to the country’s’ civil registration platform (Mukudu & Belle 2012).

2.8.8 Training and Communication

Operational challenges continue to pose a challenge to health-care professionals who work in middle to low-income countries. Inadequate resources have seen compromises being made in

providing requisite training and the much needed collaborative knowledge sharing among health-care practitioners (De Tolly & Benjamin 2012). The situation is further compounded by the use of traditional administrative techniques that significantly lessen their ability to deliver on the core function – which is providing health-care (De Tolly & Benjamin 2012). It is against this background that advances in mobile applications have brought about structural and operational efficiencies in the health-care profession. Patient diagnosis can now be concluded expediently using vast e-health online repositories in the process capacitating these professionals with on-the-job training (Chang et al. 2011). The ease with which in-service training is now being attained through mobile applications has made it possible for health-care trainers or health-care content developers to engage practitioners through collaborative data exchange and virtual learning exercises (Chang et al. 2011). Information sharing has reduced duplicity in diagnostic evaluations and has helped focus minds in instances where an ailment has proven complex, such as was the case in ebola outbreaks in West Africa (Chib, et.al 2014). A mobile application which has provided an integrated support system to health-care technicians has been Pakistan's Health Line (Varshney, 2014). Its basic algorithm means that even elementary level health-care workers are able to understand it. The application's use of local languages delivered through an audio platform has the potential to make it accessible to ordinary people other than health-care technicians only (Vital Wave Consulting 2009).

2.8.9 Remote monitoring

One of the contributing factors to deaths in the remote parts of the developing world has been the difficulty of civilians in accessing vital health information that could have prevented those deaths in the first instance (Vital Wave Consulting 2009). Even worse are cases where, if a sick individual visits a health center, the inadequacy of facilities to care for them often meant that they either have to be sent away or be kept in sub-standard conditions. A viable alternative in the form of remote monitoring has provided a ready answer to overcome this predicament. Outpatients stand to benefit from this innovation because they can forego visiting a health center and opt instead to be given a remote-checkup on the phone and the type of medication that they should have. Besides informing patients of their next appointment, mobile phones have the added advantage of letting them know when and how they should take their treatment (Chen & Kaufman 2010). In some cases, developers of eHealth software have sought to make their technologies more interactive by allowing users to give details about their medicine intake, condition of their health and any questions they might have on their health (Chang et al. 2011; Singh et al. 2012; De Tolly & Benjamin 2012).

South Africa's Cell-Life Aftercare is a remote monitoring application that has revolutionized the way in which health-care workers interact with HIV-positive patients (Willmers & Hodgkinson-Williams 2013). Their data-enabled phones which they take during home visits enable them to collect the medical history of patients in as far as it relates to their treatment compliance, state of health and any mitigating factors that might affect their health in the short to long term (Vital Wave Consulting, 2009). Cell-Life Aftercares' major advantage has been its ability to give patients the privacy they need to avoid the stigmatization that is often given to HIV-patients at health-care centers (Lefebvre 2013).

2.9 Examples of mobile applications in use in the developing countries

Next some examples of mobile applications in developing countries are discussed.

2.9.1 Mom Connect

South Africa's National Department of Health pioneered a mobile health service called MomConnect that uses the short messaging service (SMS) function to register pregnant women. Implemented in partnership with the Mobile Alliance for Maternal Action (MAMA), the initiative provides antenatal support to women registered through its system by sending them advice during and after the pregnancy – including care for their new-born babies (Western Cape Government, 2013).

The objectives of MomConnect are:

- Registration of a pregnancy at a government facility
- Aggregating information to send stage-based personalized messages to pregnant women captured in the system.
- Giving women a platform to become active participants in the antenatal health delivery system through helpdesk tools and services.

MomConnect aims to optimize mobile health technology tools and messaging applications to sensitise expectant women on the services available to them and their unborn babies.

Relatedly, MomConnect aspires to increase access to maternal health-care and facilitate accountability among those providing this service. The emphasis on accountability is designed to encourage ease of access, reach and quality of care given to women and their children (Western Cape Government, 2013).

2.9.2 Mo Tech

In 2014, a collaborative partnership between the Ghana Health Service, the University of Columbia and the Grameen Foundation saw the establishment of the “Mobile Technology for Community Health” (MoTech) (Ghana Millennium Development Report, 2014). MoTech seeks to harness the potential of mobile phone applications to cater for the health needs of pregnant women and young children in Ghana's Upper East Region - an area with high poverty levels and an endemic proliferation of diseases such as malaria, child birth complications and high mortality rates (Grameen Foundation, 2012). The research program was able to identify a myriad of challenges faced by local residents in accessing quality health-care. The most notable findings that emerged from this inquiry include a heavy reliance on paper-based health administration by health centres, an uncoordinated postnatal health-care system, traditional beliefs that promote risky behavior among patients and unavailability of accurate health-care information for women. Appreciative of these obstacles, MoTech is thus modelled to overcome them and has become an integral part of Ghana’s Health-care System – especially as it relates to caring for pregnant women.

MoTech’s major strength is its ability to facilitate an interactive engagement between patients and health professionals. While women with mobile phones are able to receive ailment specific information from MoTech, nurses on the other hand are able to use MoTech phones to enter data and simultaneously receive system generated messages on patients who are defaulting on their appointments. The information generated during these processes is used for reporting purposes by district and regional health planners (Macleod et al. 2012).

The MoTech software platform is driven by two applications, namely Mobile Midwife and the Nurses application. The former is an alert-based information service that uses text and voice messages (in local languages) to remind expectant women of their antenatal care appointments and information on how they should take care of themselves. The Nurses Application is a data capturing tool that allows nurses to record and keep track of the care provided to newborn babies and their mothers. Information entered into the MoTech software is synched with biographical patient information already held by the Ghana Health Service. This allows for reminders to be automatically activated and sent to nurses (and patients) in cases where the latter misses an appointment (Grameen Foundation, 2012).

2.9.3 Medic Mobile

Malawi's Ministry of Health pioneered Medic Mobile, a mHealth application that is designed to ensure that the health of pregnant women and their newborn babies in an area called Kilifi is preserved through the use of mobile phones (Medic Mobile, Annual Report, 2013). Medic Mobile places greater emphasis on biographical data collection where a pregnant woman's name, age, potential health complications and projected delivery date are sent to a central Medic Mobile database. Medic Mobile then aggregates this information and generates appointment schedules that are then used by health outreach workers to visit patients (Medic Mobile, Annual report, 2013). During their scheduled visits, when health workers detect a health threat they use their mobile devices to contact health a center for possible emergency care. Medic Mobile has had immediate impact in that the number of women giving birth in health facilities has increased by more than 100% from 20 to 48 live births during the pilot phase. It has also been noted that there has been an improvement in interaction between health workers and community workers through the e-learning opportunities offered by Medic Mobile (Medic Mobile Annual report, 2013).

Medic Mobile operates on multiple devices some of which include desktop computers, features phones, tablets and smartphones – making it applicable to a variety of users within the healthcare delivery system. The short messaging function is the primary tool of engagement where patients and health workers submit information to a centralized database for health management purposes. In return, health outreach workers can use their phones to receive information on how best they can care for community members. Medic Mobile also has an inbuilt analytics system that allows health managers to analyze data gathered from health outreach activities.

2.10 Challenges to the adoption of HIT's in health-care

Health Information technologies, within the context of developing countries, are not without their challenges. Most of these countries are still grappling with high levels of illiteracy, moderate levels of technology use, language barriers and the general affordability of mobile phones (Chang et al. 2011; deTolly & Benjamin 2012). There are a lot of challenges to the adoption of HIT in health-care service delivery and such challenges provide information on some of the factors that are worth considering in building up framework for HIT adoption.

The use of HIT in developing countries can help in the provision of basic needs by improving the quality of health-care. However Braa (2014) laments that the delivery and management of health services to deprived communities and regions in developing countries is a truly difficult task. Warden and Singer (2014) further denote that developing countries face major challenges that need to be dismantled before implying proper access and effective use of ICT. According to Cullinan (2016), four main challenges in HIT adoption are physical access due to expensive hardware, poor ICT skills, negative attitudes and highly technical content. The aforementioned point is complemented by Lluch & Abadie (2013) by saying that it is well known that lack of up to date information in health-care is a common problem in developing countries, which may be caused by the challenges mentioned above.

According to Kedar et al. (2012), in spite of the support for the exciting benefits of eHealth, a number of impediments continue to stand in the way of its widespread adoption by health organizations and consumers. Most consumers are still not aware that they may access specialist knowledge online. Ganesh (2014) also argues that eHealth has a number of challenges to overcome before it can be integrated into the overall fabric of health-care.

In developing countries, the public health sector sinks in lots of challenges and health technologies have been suggested as a reasonable technological strategy that may offer a set of new and creative health solutions (Isabalija, Mbarika & Kituyi, 2013). Kifle & Mbarika (2012) advocate that, developments in communication technologies such as internet, 3G cell phones, cheaper and yet powerful hardware over the past decade have paved the way to the evolution of eHealth, which uses internet oriented technologies to provide quality health services to people from remotely dispersed sites. While research findings from (Kreps & Nehauser, 2010) have reported a notable growth in the diffusion of internet in most developing countries, it is generally a known fact that most of the people in such countries, especially the part of rural Africa, which represent the majority of the African populace, have limited information access, no electricity, no internet and most importantly are illiterate.

2.11 Maternal health-care services in Zimbabwe

Health needs for most of the Zimbabweans are catered by the Public health sector which is run by the Ministry of Health and Child Welfare. However, this sector has its challenges which include shortage of resources (equipment and staff). As a result of this, there is overcrowding in hospitals and long waiting times (WHO,2014). Generally, the delivery of services is very poor (WHO, 2014). Maternal mortality continues to be a major challenge in

Zimbabwe with most deaths related to inadequate maternal care (Sellassi & Fomunyam, 2012). The first point of care is located within communities in community clinics and community health-care centres. If complications are encountered, patients are referred to district hospitals followed by provincial hospitals and finally to the central hospitals.

The maternal mortality ratio was estimated at 725 per 100 000 live births (WHO, 2014). This is much higher than the MDG target for MMR for Zimbabwe which is 174 per 100 000 live births. Sadly, the major causes of maternal mortality reported in health facilities are preventable with good access to health-care services. WHO recommends at least 4 ANC visits for each pregnancy with the first occurring within 16 weeks of pregnancy (WHO, 2014). The high levels of at least one antenatal care (ANC) visit (94%) are followed by fewer women completing at least four ANC visits (71%) (WHO, 2014). Even fewer women return to deliver in the institutions where skilled attendance at birth can be accessed (WHO, 2014). It is estimated that in 2009 39% of women who gave birth in the two years prior to the survey delivered without the assistance of a skilled birth attendant (UNDP, 2013). Only 1 in 3 rural women in developing countries receive the recommended care during pregnancy (UN 2012). There was need for a 75 % reduction in maternal mortality by 2015 to meet the Millennium Development Goals (MDG) (Phiri, 2016). The Zimbabwe Maternal and Perinatal Mortality Study (ZMPMS, 2013) identified the leading direct causes of maternal mortality in Zimbabwe as attributed to the three delays namely: (1) the delay in deciding to seek health-care services, (2) the delay to reach a health-care facility once a decision to seek care has been made due to long distance, transportation and infrastructure and (3) the delay to access care at the health facility due to inadequate staffing, training, equipment etc.

2.12 Proposed model

In order to realize the full potential and promise of mobile health technologies for maternal health services in Zimbabwe's public hospitals' maternal units, a better understanding of the people (health-care service providers and expectant women), Health information Technologies currently being used in hospitals, mobile phones usage rate and environmental factors is required. This study seeks to exploit the potential of mHealth applications and technologies in maternal health-care in Zimbabwe. The landscape model is the framework that was used.

A framework is a conceptual structure designed to serve as a support or guide for the building of something that expands the structure into something useful (Rousse, 2010). Frameworks,

models and taxonomies are all approaches which help to structure and classify concepts and relationships in a subject.

The focus of this research is on the service provision of health-care facilities to expectant women based on their needs experienced during their pregnancy. As was indicated in the literature review there is specific needs relating to health information and it is important to determine the information needs of the service providers and the pregnant women. Information is used on the work context of the service providers and by the pregnant women. The research will also consider the current and potential use of health information technologies to facilitate the maternal health-care services and information exchanges. Services are typically influenced by contextual factors that are typical of that context. In this study the contextual factors of the country are considered to determine to what extent these influences maternal health-care service provision in Zimbabwe.

2.13 Conclusion

The forgoing chapter provided a contextual analysis of available literature on the general state of maternal health-care in developing countries, with a particular emphasis on Zimbabwe. The reviewed body of knowledge indicated that while there is a deliberate policy focus on ICT adoption in the maternal health sector, implementation remains a challenge. mHealth has taken root in countries such as South Africa, Kenya and Uganda – where mobile applications have seen better coordination between health professionals and patients. Zimbabwe's mHealth adoption remains in its infancy. Its maternal health sector is faced with conventional challenges affecting other developing countries such as maternal mortality, new born infant death and pregnancy complications. Despite these challenges, the scholarly work reviewed in this chapter indicates that ICT adoption and implementation remains hamstrung by limited resources and lethargy by policy makers. Capacity development in mHealth utilization was revealed as an area where opportunities exist for patients to become active participants in the health-care delivery system.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter highlights the details of the relevant and appropriate research methods adopted for this study. Comprehensive details are provided as to how, where and when the research was carried out. This study employed an approach which is interpretive to a multi-case study for the empirical research presented (Saunders & Tosey, 2013). A multi-case study approach was proved to be a methodology which is suitable to study ICTs as social systems, in which the aim is to explore and exploit the potential of mHealth applications and technology to facilitate better maternal health-care services in a developing context. More-so, case-study research constitutes an adequate empirical enquiry which will help in investigating a contemporary phenomenon, in this case mobile technologies, within its real-life context, where boundaries between the phenomenon and the context are not clearly evident, and in which multiple sources of evidence are used (Yin, 2014).

Qualitative research methods in the form of open-ended interviews were conducted with personnel from the Ministry of Health in Zimbabwe and facilities personnel. Descriptive details of the sampling procedures, the data collection methods and techniques of data analysis are all discussed in this chapter. Intuitive and subjective observations by the research also played a role in achieving the objectives of the study.

3.2 Case Sites

This study was conducted in Harare, in the capital city of Zimbabwe. Focus on the research area of the study was given to two public hospitals maternal units (Parirenyatwa and Harare Hospitals). Parirenyatwa and Harare hospitals are among some of the largest referral hospitals in Zimbabwe and their antenatal units serve a sizeable part of the population. This makes them natural choices on an investigation on maternal health and its related technologies. The two hospitals also have the most experienced and educated obstetricians and midwives.

3.2.1 Suitability of study location

Harare was chosen for the particular study because it is the primary launch-pad of any health plan decided upon by the national government. It therefore provides a critical window of insight into any research inquiry on health issues in Zimbabwe.

3.3 Public Health-care in Zimbabwe

Zimbabwe health-care facility system is diversified and it's operated by a diverse range of actors. The public health system is the major service provider of health-care services, assisted by Mission hospitals as well as health-care which is rendered by non-governmental organizations (NGOs). Public health-care is given at four levels. These four levels are intended to function as a referral chain (Zimbabwe Ministry of Health and Child Welfare, 2013). Expectant women are expected to present themselves first at the first level facilities (urban clinics) and then be referred upwards if the case requires such a referral. First referral level facilities will be District hospitals followed by Provincial or General Hospitals and then lastly Central or Special hospitals.

3.3.1 Parirenyatwa Hospital

Parirenyatwa Hospital is the largest medical centre in Zimbabwe. This medical facility is located in the Belgravia and it sits on a 400 000 square meter piece of land. Additionally, the hospital is also used as a centre for courses run by the University of Zimbabwe and the Ministry of Health and Child Welfare like Basic Nursing Course and also Post Basic Nursing Course. Courses offered include midwifery, operating theatre nursing and ophthalmic nursing. The group of hospitals is made up of Mbuya Nehanda, which is a maternity section, Sekuru Kaguvi, a section that specializes in eye treatment; and an annex for patients with psychiatric issues as well as several specialist paediatric wards. Mbuya Nehanda Maternity Hospital unit is comprised of antenatal care and family planning units. The purpose of this unit is to provide material child health-care to all clients seeking medical assistance. The people who get medical attention from this health facility are drawn from the designated zones by way of the referral system and from the obstetricians who have got the right to admit private patients into the hospital (Rasmussen & Rubert, 2011).

3. 3.2 Harare Central Hospital (HCH)

Harare Central Hospital is the main hospital in Harare that takes all referrals from Harare clinics and also other provinces in the country. Harare Central Hospital has the largest referral maternity unit in the country and it caters mostly for low income patients. The hospital is located in the suburb of Southerton in Harare. Just like Parirenyatwa hospital it is also used as a training institution for nurses but it has had a severe shortage of equipment and reading material in the library so as to enable students to conduct research. The institution has

enough medical equipment but due to the fact that its catchment area is large covering majority of the surrounding high-density residential areas as well as outside the greater Harare residential area and also some of the patients who do not have the financial capacity to pay for their medical consultations.

3.4 The Research Process

Consent forms, with clear explanations of the research purpose were distributed before the interview sessions were conducted. To identify the participants, snowball and purposive sampling were used since the research is qualitative. In-depth semi structured interviews were carried out with expectant women who use the Harare and Parirenyatwa group of hospitals for maternal health-care, midwives and doctors, as well as the Information Technology staff for the two hospitals to explore the potential of mHealth technologies for maternal health-care so as to exploit it thereafter. The researcher also recorded interviews and also wrote down some field notes. Soon after the data collection, data analysis followed.

3.4.1 Recruitment of Participants

The sample recruitment was at first done using purposive sampling method of women who have undergone antenatal care and given birth together with those who were currently pregnant and nearing delivery and women who were receiving antenatal at Harare and Parirenyatwa hospitals. In purposive sampling, the researcher chooses participants for a specific purpose based on the aim of the study (Bernard, 2016). The two hospitals were chosen because they are the biggest hospitals that provide maternal health-care services in Zimbabwe.

The researcher was given access to the bibliographic records of past and present patients of the antenatal units. This enabled the researcher to contact 25 women who receive antenatal care from the 2 hospitals. Further access was secured to interview 15 maternal health-care service providers who work at the 2 hospitals and 5 Information Technology support personnel as well. The researcher then talked to them concerning the research project and sought their interest in participating in the study. The service providers, expectant women and Information Technology staff were included as respondents because leaving one of the three would give inadequate information about the potential of mHealth application for maternal health services.

In addition to purposive sampling, snowball sampling was also used whereby the researcher further made use of social networks among the respondents so as to get more people participating. Bernard (2012) stated that in snowball sampling researchers use key informants to identify one or two key informants who can assist to recommend others in the community whom the researcher can interview. Thus this sampling method allows for the inclusion of some respondents identified by asking other women who have received antenatal care and delivery in Harare's public health-care system. 10 women were selected through purposive sampling (Bernard 2016), and the other 15 were selected through snowball sampling, through referral from the other interviewed women to make a total of twenty five participants (Bernard 2016). 2 midwives were selected through purposive sampling and 13 more through snowball sampling, through referral from the two interviewed midwives. Snowball sampling enabled me to gain trust from the participants as I was referred to them by someone they trust. For the 5 IT staff, I used purposive sampling only.

3.4.2 Qualitative Research

This study employed qualitative approach as research questions and objectives of this study required qualitative research methods. When using qualitative research, the information given by participants is not presented in a numerical manner since emphasis is given to stated experiences of the participants and on the stated meanings they attach to themselves, to other people and to their environment (Coolican,2014). Coolican (2014) argues that qualitative methods assist the researcher to gain an insight on nature and meaning of reality that is shaped by a society, by means of the close relationship between the researcher and the subjects of the study and the surrounding environment. Joubish (2011: 48) notes that, "qualitative research is an inquiry process of understanding a social or human problem based on building a complex holistic picture, formed with words, reporting detailed views of informants and conducted in a natural setting". Qualitative research approach pays particular attention to processes and meanings that are not rigorously examined and measured that is if measured at all in terms of intensity, amount, frequency or quantity (Joubish, 2011). Therefore in this study the researcher made use of a qualitative approach so as to study and analyse individuals in their natural setting and to establish the researcher's role as an active learner who can tell the story from the participants' viewpoint rather than as an expert who passes judgements on participants. The researcher utilised sampling and data collection strategies that are typically suited for a qualitative study. Also the interviews were conducted

in Shona which is the most popular language in Zimbabwe and as well the researcher's native language and then translated into English.

Key informant interviews were done to assist in this process. Carter and Beaulieu (2012) define key informant interviews as qualitative in depth interviews with people who know what is going on the community. According to Mountain States Group, Inc. (2009) key informant interviews:

- Aids the interviewer in establishing a rapport with the respondent and clarify questions.
- Can raise awareness, interest, and enthusiasm around an issue.
- Provide details and data that can be put together in a relatively easy and cheap way
- Provide opportunity for building and strengthening relationships with key community informants and stakeholders

However, the use of key informants has its disadvantages such as: difficulties in selecting the "right" key informants as they might represent diverse backgrounds and viewpoints (The Access Project; 2009) It is also challenging to reach and schedule interviews with busy respondents.

3.5 Data Collection

In this sub section more details about the collection of data are provided. Data was collected from various sources. The researcher used both primary and secondary sources.

3.5.1 Primary Data

This study used in-depth interviews to collect primary data from the research participants and these were complemented by observations and field notes. Three separate interviews were done with 15 maternal health-care providers, 25 expectant women and 5 Information and Technology support team.

3.5.2 Secondary Data

Books, journals, publications and websites were some of the relevant sources of information that were used to gather the data on the potential of mobile health technologies for maternal health services.

3.5.3 Data Collection Tools: Semi-Structured interviews

The primary data collection method used to explore the potential of health applications and technologies for the Zimbabwean maternal health-care in this study was in-depth semi structured interviews. With semi-structured interviews, both the interviewer and the interviewee are equal partners. The interviewer knows the areas he or she wants to cover with the interviewee, but allows the interviewee the options to take different paths and explore different thoughts. The format of the semi-structured interview allows for deviation in the discussions although there is enough structure to ensure that all the important topics are answered (Nicholls, 2009). The interviews were one on one which means that there were many advantages with this method such as: interviewees tend to share a lot more information when the interviewer is asking the questions in person, interviewees are given opportunities to participate in a more direct way and also they will be more comfortable in sharing their experiences.

The participants were contacted through word of mouth to set time for the interviews. The interviews sessions were conducted at Parirenyatwa and Harare Hospitals. During the course of the interviews, the chronology of the questions was not adhered to in the same format. The sessions lasted for about thirty (30) minutes.

3.6 Data Analysis

This research is mainly qualitative, in that data is descriptive and explanatory rather than statistical. Qualitative data analysis is an iterative and reflexive process that begins as data is being collected rather than after data collection has ceased (Stake, 2015). The researcher used content and thematic analysis for analysing interviews where the unit of analysis included, health-care professionals which included midwives and doctors, pregnant women and IT staff from both case sites (Palmquist, 2013).

3.6.1 Content Analysis

Content Analysis is the appropriate technique that will be used in the study. This method is used to examine words or phrases from a number of sources such as literature, interviews and questionnaires (Palmquist, 2013). A number of definitions of Content Analysis are available. It has been defined as a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding (Weber, 2010). It is a method for summarizing any form of content by counting various aspects of the content. This enables

a more objective evaluation than comparing content based on the impressions of a listener. This method focuses on those themes and phrases used most frequently, and the researcher takes note of these with specific attention on how they are presented (Robson, 2012). In Content Analysis, the most frequent words, phrases and those with similar meanings are grouped together and used as the basis of analysis (Weber, 2010). This method is suitable for analysing text from documents. As for Weber (2010) it is a research methodology that utilizes a set of procedures to make valid inferences from the text. These inferences are about sender(s) of the message, the message itself, or the audience of the message.

3.6.2 Thematic Analysis

Thematic analysis is a method that is qualitative research useful for describing and coding data collected from research participants (Fereday & Muir-Cohrane, 2011). Braun and Clarke (2011) define thematic analysis as: "A method for identifying, analysing and reporting patterns within data." This method is widely used in qualitative research analysis. According to Boyatzis (2008), thematic analysis is a process of "encoding qualitative information". He further explains that these codes can be organized into themes. Researchers review their data, make notes and begin to sort it into categories or themes hence in its simplest form; it is a categorizing strategy for qualitative research. Thematic analysis helps researchers move their analysis from a broad reading of the data towards discovering patterns and developing themes. Many researchers use thematic analysis as a way of getting close to their data and developing some deeper appreciation of the content (Braun & Clarke 2011).

3.7 Ethical Considerations

It is of importance to seek consent from participants. They need to be fully informed about the research objectives, their roles and consequences (Henning, Van Rensburg & Smit, 2014). Consent forms, with clear explanations of the purpose of the research and how the data will be handled were distributed prior to the interview to give the interviewee the option to accept or decline participation. The respondents were briefed on the purpose of the study and were allowed to ask questions on the parts they did not understand. The respondents were informed that they could withdraw from the interview at any stage and they were assured that their answers will be confidential.

The researcher and the participants signed the consent forms as an agreement on the confidentiality terms of the interview. No private patient data was used at any stage. Questions about patient data were in all cases in general and not about specific data values.

3.8 Summary and Conclusion

In conclusion, this chapter outlined the methodological framework used to investigate the potential of mHealth technologies for maternal health-care. Since this is a qualitative study, data acquisition instruments such as purposive and snowball sampling were used. These instruments provided the framework for the interview questions that were used for collecting primary data. The analysis of the data collected was carried out using the content and thematic analysis paradigm. Use of this paradigm was influenced by its deliberate emphasis on identifying recurring themes in primary data.

CHAPTER 4: RESEARCH FINDINGS AND ANALYSIS

4.1 Introduction

This chapter presents the results gathered from the interviews that were conducted at both Parirenyatwa and Harare hospitals in Zimbabwe. 45 participants (15 health-care providers which include midwives and doctors, 25 expectant women and 5 Information Technology staff) were drawn from the 2 hospitals. They were recruited and selected as explained in the previous chapter. A semi-structured interview schedule was used. The participants articulated their experiences of the current activities in maternal health. A mobile phone was used to capture the conversations as they happened and soon after the interviews, the information was transcribed.

The aim was to gather information from the participants on the current problems that they were facing in as far as maternal health-care was concerned and also how mobile application could be used to solve some of the problems in order to ultimately curb maternal deaths. The interview schedule for the expectant women was divided into three sections:

- Section A: Demography
- Section B: General maternal health questions
- Section C: Technical questions

(Refer to Appendix G where the interview schedule can be found)

The interview schedule for the health-care workers was divided into 2 sections only:

- Section A: General Maternal Health Questions.
- Section B: Technical Questions.

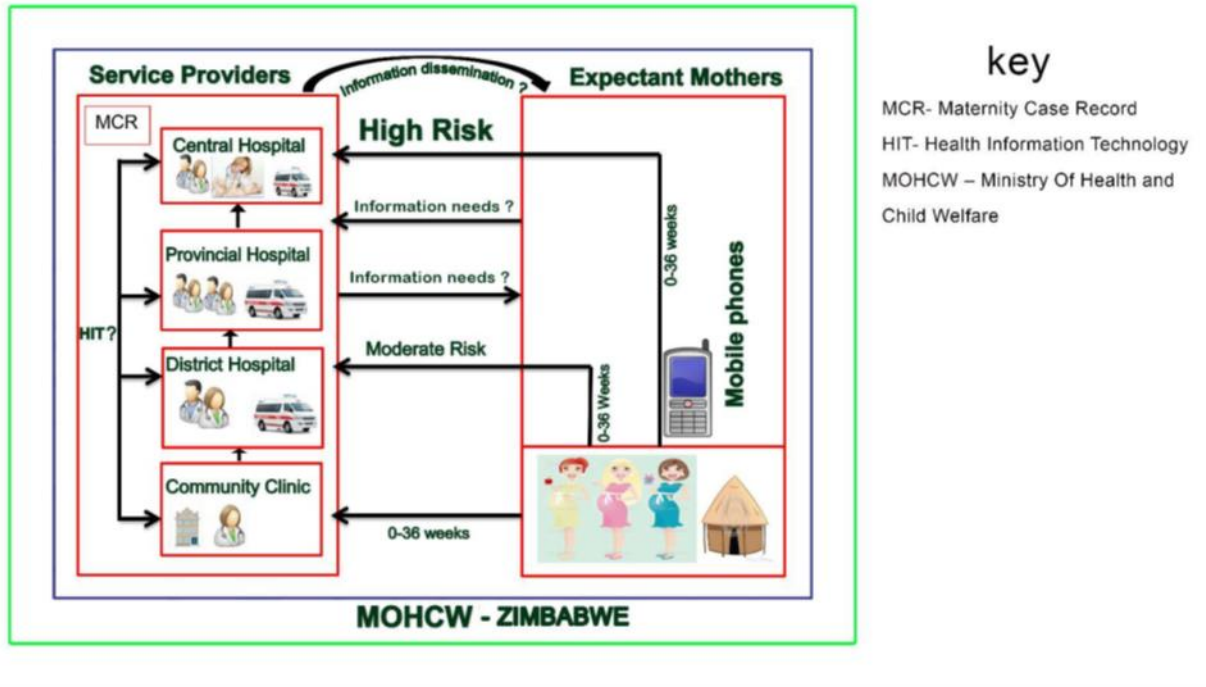
The interview schedule for the Information Technology staff has only one section:

- Technical Questions

4.2 Analysis

This research study was based on the concepts identified in the literature. Furthermore the following are also included in the diagram below, i.e the process of how maternal health information is disseminated; information needs of maternal health-care providers and expectant women as well as the Health Information Technologies currently in use in the

hospitals. The Model below is a depiction of the prevailing information architecture system in Zimbabwe’s maternal health system as used by the Parirenyatwa and Harare hospitals:



The proposed conceptual model assisted with focusing the research on the specific aspects based on the research problem for this study. The data collected from the interviews and observations were then analysed using the thematic analysis method. The data was read and codes were generated. The codes were then grouped to form sub themes and the themes were derived from grouping the sub-themes.

| Theme | Sub themes |
|-------------------------------|--|
| Health-care facilities | <ul style="list-style-type: none"> • Levels • Referrals |
| Maternal health-care services | <ul style="list-style-type: none"> • Types of services • In/outside hospital services • Scheduled appointments • Role of health-care professional • Complicated pregnancies |
| Maternal health information | <ul style="list-style-type: none"> • Maternal health record |

| | |
|-----------------------------------|--|
| | <ul style="list-style-type: none"> • Information flows • Information access • Information dissemination |
| Maternal health information | <ul style="list-style-type: none"> • Maternal health record • Information flows • Information access • Information dissemination |
| Maternal health information needs | <ul style="list-style-type: none"> • Information needs • Information expectations |
| ICT use | <ul style="list-style-type: none"> • Information systems |

4.3 Health-care Facilities

Parirenyatwa and Harare hospitals are major referral health-care centers that, in addition to taking care of ordinary birth deliveries are also responsible for handling the more complex and difficult pregnancies. These two hospitals are at the pinnacle of the health information superstructure where they direct the dissemination of information to patients through intermediary health-care centres at provincial, district and rural levels.

Driven by a National Health Information Strategy formulated by the Ministry of Health and Child Welfare, Parirenyatwa and Harare Hospitals have a relatively well developed in-house information and communication infrastructure. This infrastructure is a consequence of the research-intensive nursing schools that are located within the premises of the hospitals. Health professionals from the hospitals have unlimited access to the network-enabled research centres where they are able to conduct medical research on complex antenatal cases. The information generated from these research inquiries is for their own professional use or for sharing with colleagues and rarely with patients.

The level of the antenatal care system is staggered according to the following levels:

| JURISDICTIONAL LEVEL | TYPE OF CARE | FACILITY |
|-----------------------------|----------------------------|---------------------------|
| National | Critical care | Selected level 3 hospital |
| Provincial | Tertiary Level of referral | Level 3 Hospital |

| | | |
|------------------------|-------------------------------|--------------------------------------|
| District Council | Secondary level of referral | Level 2 hospital |
| District sub-structure | Primary level of referral | Level 1 hospital |
| Community | First level of medical care | Community health centres, clinics |
| Home | Self and Community based care | Outreach (Community Health Workers). |

Zimbabwe's health system is an integrated system of health establishments which consists of clinics, community health facilities and a three-tier hospital system that are interconnected through a referral system designed to deal with the severity of pregnancy cases. The framework provides a cascading system of responsibility and authority from the centre of the periphery and facilitates a centripetal flow of data, information and experiences from the community inwards to government.

The key findings derived from the analysis of the health-care facilities are:

- Both the health-care facilities have a relatively well developed in-house information and communication infrastructure a consequence of the research-intensive nursing schools that are located within the premises of the hospitals.
- Health professionals from the hospitals have unlimited access to the network-enabled research centres where they are able to conduct medical research on complex antenatal cases.
- The information generated from these research inquiries is for their own professional use or for sharing with colleagues and rarely with patients.

4.4 Maternal health-care service provision: Health-care professional

The health-care professionals interviewed for this study (midwives and doctors), see their role as two-pronged. They not only administer treatment to patients but also dispense general health tips as part of a health promotion function. However, the pressure to attend to as many patients as possible within a given time period due to the shortage of health personnel, means that the information given to a patient during a regular appointment is basic and cannot be explained further. This is despite the fact that almost all people who visit health-care centres see them as their only source for health related information.

The daily routine and professional profile of one of the doctors interviewed for this study, who works in the antenatal unit at Harare hospital, provided some insights on the role of a health professional in maternal health provision. The doctor identified his role as the identification and treatment of complications and the promotion of healthy behaviours. In addition, the professional duties also include the provision of counselling and education service to the expectant women. On average, this doctor explained, “Antenatal visits by expected women range from 7-11 visits. The frequency of these visits is in most cases determined by the needs and risks of each patient”. Comprehensive physical examinations are done during these visits to establish a client-specific management plan that will determine how a pregnancy will be taken care of until birth. Education sessions, which are all conducted on-site, include topics such as promotion of healthy behaviours, nutrition, continued exercise, avoiding substance and hazardous chemical exposure

As pregnancies progressed, from conception to birth, midwives at the hospitals under study showed a keen interest to be involved throughout the whole process. Of particular note is how they asked pertinent questions to expecting women on how their pregnancies were progressing and if there was any nagging discomfort in their condition. In cases where the midwives encounter a ‘difficult pregnancy’ which may require constant monitoring beyond the walls of the hospital, the researcher noticed that patients were given their regular check-ups and dismissed without any after-care information support.

Perhaps the most challenging cases for midwives were expecting women who registered late for their antenatal care and monitoring programme. The challenges posed by such negligence is the difficulty midwives experience in establishing risks (if any) that might be facing a late registration and the nature of off-site support that it might need to ensure that the woman and baby remain healthy. In most cases, the inability to register on time was largely a function of the absence of tools to assist expectant women to notify a remote health centre that they are pregnant. If remote notifications to hospitals were to be made mainstream, this could give the latter the ability to encourage expectant women to visit a health centre for physical examination and care.

Midwives are an integral part of the antenatal health sector and the expectations that they have of expectant women should be taken into consideration, if one is to have an appreciation of the dynamics of information exchange within the health sector.

The fifteen health-care service providers interviewed for this study expressed concern on the limited interaction that they have with expectant women beyond the regular check-ups and the day of delivery. One of the midwives interviewed had this to say:

“Some pregnancies have unique challenges and require constant monitoring over and above the regular check-ups. Due to limited resources, we however cannot ask these special cases to deviate from their regular appointment schedules and make unscheduled visits”

Besides the barriers to communication, health-care service providers also highlighted the challenges they face in dealing with expectant women who do not subscribe to set antenatal methods of operation at health-care centres. A common problem is expectant women who register late for regular observation or who fail to turn up for scheduled appointments. Another midwife who was also interviewed was of the view that:

“.....women who register late need to be monitored regularlyeven beyond the walls of the hospital. The difficulty is that we do not have the technology or resources to ensure constant feedback from patients. We are made to rely on the visits they make to health-care centres, that is if they decide to show up”

The general sentiment that the women expressed was that the general waiting period to see a health professional should be reduced and expedited to limit the stress levels of waiting in the queue for long periods of time. When asked about why check-up queues are always long despite the fact that every individual is given a different appointment date, an expectant woman, said:

.....our bodies react differently to pregnancies, there are times when we have to make unscheduled visits to the clinic to get information about what we need to do to overcome the discomfort.....if we could call someone who may assist us over the phone then these unscheduled visits may drop.

The key findings for the health-care service providers are:

- Nurses and doctors provide health-care, health promotion and counselling services
- They found the time available to see patients due to staff shortages is insufficient with the emphasis on the physical examination
- Midwives are interested in the entire pregnancy of the expectant women beyond the visits and would prefer to have more interactions with them

- Late registrations of pregnancies or missing appointments could result in a difficulty to identify risks

4.5 Maternal health-care service recipients: Expectant women

In order to understand the profile of an average Zimbabwean woman and her interaction with the antenatal health system, it is important that there be a clear outline of the characteristics defining the women who were interviewed for this study.

The average age of the twenty-five women interviewed was thirty years. While all of them had received secondary education, fifteen of them had gone on to acquire a post-secondary qualification. The unemployment rate among the respondents was very high, with 33% in formal employment.

The high marriage rate of 90% among the respondents revealed that the majority of women who were married relied on their partners for economic security. One correspondent had this to say:

Interviewer: Are you employed? If not, what is your source of income?

Interviewee1: My husband is the breadwinner..... (Laughing)...I guess that is why I should behave myself and be a good wife to him or else he will go somewhere else.

For the women who were single, their major source of income came from informal trading in second hand clothes and fresh farm produce. There was however a universal agreement that antenatal health-care in Zimbabwe, whether public or private, was expensive. Twelve of the respondents cited this as the reason why they had failed to register on time at one point in their reproductive lives.

Ten of the interviewees had feature phones while fifteen had smartphones. These two types of phones enabled them to have access to the internet and facilitate social messaging through applications such as 'WhatsApp', 'face book' or 'twitter'

In ideal circumstances, expectant women must register for their antenatal monitoring programme within a month of getting pregnant. The initial phase is to acquire information on how they should conduct themselves during the whole pregnancy. It is therefore of no coincidence to note that expectant women rely heavily on hospitals for professional advice on how they can manage the physiological changes taking place in their bodies. The only

handicap is that there are limited sources of information for expectant women outside the hospital.

An expectant woman at Parirenyatwa hospital, who was interviewed for this study, provided an account of her antenatal journey which may yet give an abstract overview about the experience of a typical woman on the antenatal services offered. She is a resident of a high density suburb in Harare called Kambuzuma. When she became pregnant, she went to register for antenatal care at her local care facility. Halfway through the monitoring process, she was told that her baby was “bridged” and that her case could no longer be attended to by the clinic. She was referred to Parirenyatwa hospital. This expectant woman, though happy that she was now being attended to by a facility with more resources, she expressed reservations that the information given to her was not enough to allay her anxieties on the condition of her baby. She hoped that further assistance on how she should handle her condition while at home, would have been more helpful. However, she felt that she was being given regular care as that which was being given to women with normal pregnancies. Now in her final month of pregnancy, doctors informed her that she would not have a normal delivery but would have to be operated on. This brought about further anxiety, depression and fear about her health and that of her baby. She said no literature was provided for her to read on how to prepare herself psychologically for the impending operation.

While almost all the women who visited the two hospitals during the time when the researcher was on site, there was not any institutional system in place to harness mobile technology to engage with their patients. mHealth is in its infancy in Zimbabwe but the slow pace at which health authorities are incorporating it into the health delivery system may end up as a lost opportunity if ICT adoption remains an in-house focus.

The key findings for the service recipients are:

- The average age of the expectant women is 35 years with a high unemployment rate
- The single expectant women obtained money through informal trading
- The expectant women indicate that health-care services in Zimbabwe are expensive and indicate that as a reason why they fail to register their pregnancies
- The expectant women have to rely on the hospital services for all their health-care needs during their pregnancies

4.6 Maternal Health-care Services Analysis

The maternal health-care services in the two cases investigated for this study are sufficient and form part of the integrated health-care system of Zimbabwe. These two hospitals have a well-developed ICT infrastructure that provides unlimited access to the research on complex cases for the health-care professionals. Both the doctors and midwives provide health promotional and educational services to the pregnant women in addition to the clinical services. The health-care professionals and expecting women find the advice relating to their pregnancies important although this aspect is not addressed outside the hospitals.

The key findings regarding the maternal health-care services are:

- The maternal health-care services inside the hospital is adequate but needs to include health promotion and education in addition to the clinical services
- The maternal health-care services outside the hospital is inadequate to meet the demand for after care or advisory services
- There are problems with scheduled appointments experienced by service providers and expectant women
- Complicated pregnancies are dealt with sufficiently with the current services at the facilities and referral facilities.

The global maternal health system is structured around a universal baseline understanding of what constitutes the needs of expectant women, how those needs should be met and what women need to do to have a successful pregnancy. However, not all pregnancies are the same and in most cases the needs of expectant women tend to vary on a case by case basis. Expectant women tend to experience varying degrees of physiological development and this impacts differently on the nature of the psychological and physical support that they need as their pregnancies develop. This is precisely why Margareta et al. (2012) posit that ‘antenatal services may need to offer customized individual support and emphasize peer support in groups....’ Customization in the developing world context, as this study revealed, can best be attained through cost effective mobile health technologies that are in regular use and can be adapted to the specific needs of an individual.

4.7 Maternal Health Information

The maternal health information will be discussed according to the derived information themes, namely: Information flows; access to maternal health information; dissemination; and Information needs.

4.7.1 Maternal Health Records

Maternal Case Records (MCR) are the Maternal Health Records which are a component of patient information systems. The MCR provides a data trail that charts the health of an individual to monitor pregnancy development. Through observation and interaction with expectant women and health professionals, the researcher was able to conclude that paper based Maternal Case Records were the standard instruments used for pregnancy monitoring at both Parirenyatwa and Harare hospitals. The Maternal Case Record gives a detailed biographical outline of patient, from their family medical history to the medications that they have used. While this is a preliminary process designed to assist health professionals get insight on their patients, the Maternal Case Record's most important role is to record the outcome of any diagnostic activity made. The diagnosis can range from blood test, urine test to physical examinations. Maternal Case Records also help health professionals schedule appointments that are critical to ensure that expectant women are under constant observation during the course of their pregnancy. All the captured information will be saved in a Maternal Case Record and expectant women are required to have these MCRs with them every time they visit the hospital.

The key findings regarding maternal case records are:

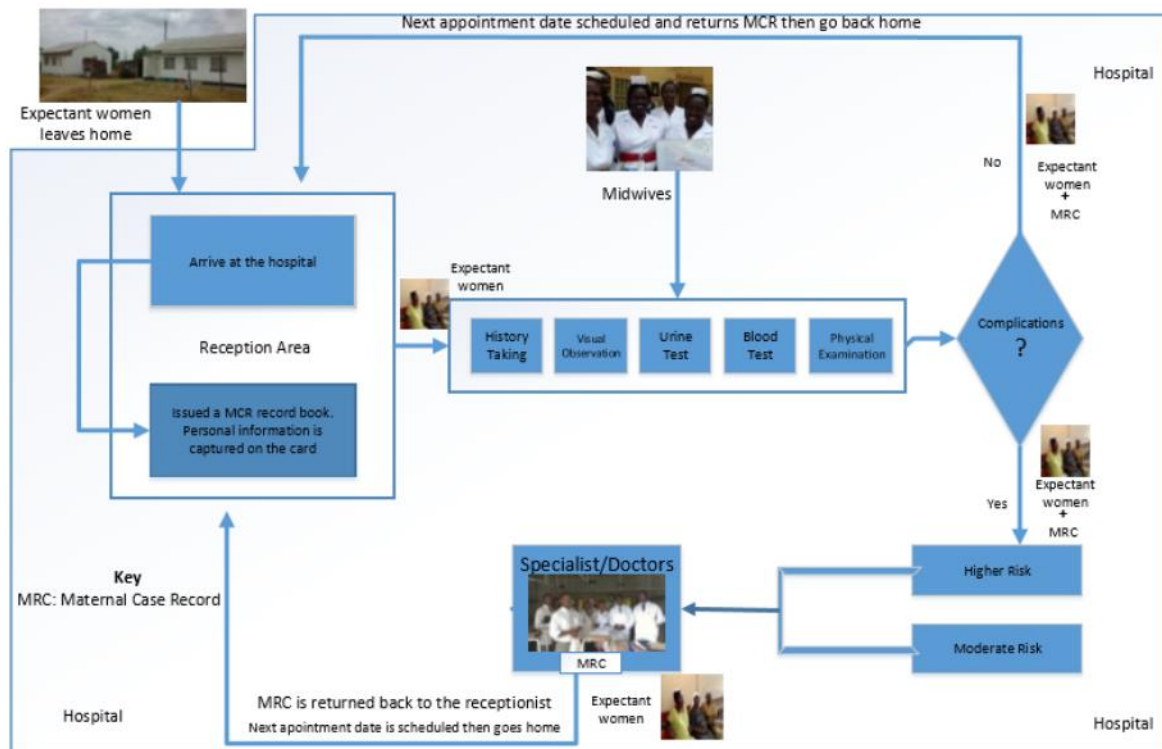
- MCRs are the standard instruments used for pregnancy monitoring at both Parirenyatwa and Harare hospitals.
- Their most important role is to record the outcome of any diagnostic activity made
- MCRs also help health professionals schedule appointments that are critical to ensure that expectant women are under constant observation during the course of their pregnancy.

4.7.2 Flow of maternal health-care information

In this sub section the information flows from the expectant women to the health facilities and between the different health facilities are discussed.

An emergent characteristic in the flow of information between health-care centres and expectant women was that the latter was relatively a passive recipient of information disseminated by the former. There was not an avenue from which the women could interrogate the information other than to subscribe to what was being dictated. This situation seems to be similar across other platforms such as pregnancy counselling and scheduled information sessions. The major disadvantage of this state of affairs is that it sometimes requires information literacy training which, in practice, rarely happens.

The diagram below depicts the different service touch points and information flows from the expectant woman's perspective:



Expectant women arrive at the hospital for booking with their Identity Documents (ID) and they are asked to complete a form.

- Expectant women are consulted by the service providers
- After completing the forms, the service providers will capture the information in a Maternity Case Record (MCR) that is a book with the patient's details.
- Each expectant woman will have her own maternity case record book

- A MCR is visible in the information communication diagram which links a midwife process in terms of recording patients' information
- Patient history and also the medication they are taking are recorded
- The diagnosis process will start. The following will be done: urine test, blood test, physical examinations etc. After the tests and assessments have been carried out the results are recorded in the MCR. The next appointment is arranged.
- The expectant women are required to have their Maternal Case Records with them for every visit thereafter until they give birth.
- Monitoring of the pregnancy and the woman's health will be monitored through regular check-ups. If there are no complications, expectant women are advised to return to the clinic after every six weeks until 28 weeks, then thereafter, as per the clinic's staff.
- Expectant Women who are diagnosed as risk cases are referred up the line to specialist doctors. Women with risk pregnancies are advised to attend outpatient antenatal clinics as often as necessary.
- The health facility gives all women a Road to Health Chart (RTHC) when the baby is born. This card is kept at home and must be given to the sister on follow-up visits to the clinic. The card is an ongoing record of the child's health from birth to five years of age.

Information Flow

- Referral hospitals act as a convergence zone where medical specialist skills in maternal health-care are harnessed to minimize the danger of at risk pregnant women.
- Expectant Women who are diagnosed as risk cases are referred up the line to specialist doctors.
- All the information about their health will be written in the maternal case record so at risk women will just carry the maternal case record to the specialists.
- The specialist will get all the necessary information from the patient's MCR
- Tests and examinations will start
- Additional information pertaining to the complicated pregnancy will be captured in the MCR by the specialist
- If there is more information that the specialists require, they will contact the referring hospital via phone calls

- The patient's next appointment date will be captured in the MCR
- The MCR is returned to the referring facility by the referral facility
- MCRs are kept at the primary health facility.

The Health centres and health professionals working in antenatal units provide a health-care service to expectant women to ensure that they have access to basic antenatal care during their pregnancies and after the delivery of the babies.

The key findings regarding information flow are:

- MCR plays a pivotal role in the information flow as it is the mode of communication between the service providers and the expectant women
- The Maternal Case Record is kept at the hospital to be used for visits.
- In the case of complications the expectant woman is referred to the next level within the same hospital to be seen by the specialist who writes the details in the MCR that is returned to the reception afterwards.

4.7.3 Access to Antenatal Information

The usefulness and relevance of antenatal information can only be measured at the rate at which it is used by expectant women. It is therefore important to understand how expectant women wish to access information from health-care centres.

This inquiry was able to establish that, while access to antenatal health information was a function of where it was delivered, expectant women were also concerned about how it was delivered. A three month pregnant woman at Harare Hospital pointed out that more pictorial presentations and less text can make information easily understandable. When prodded by the researcher about what she meant, she had this to say:

Researcher: When you say information should be presented more in pictorial form rather than paragraphs of explanatory text, are you saying that information is not useful in the current form in which it is being delivered?

Interviewee: The current form is okay.....all I'm saying is it should not take time for me to understand what is being said.....pictures make me understand better and quickly.

Researcher: Do you see cell-phones playing a role in how this information is delivered to you?

Interviewee: We already receive pictures with text through WhatsApp (the social messaging mobile application), so it should not be difficult for our doctors and nurses to give us information using the same format.

Information literacy training was identified as one of the areas where health-care centres could help expectant women to access information. When the researcher made presentations to ten of the twenty-five women interviewed on how they could use their mobile phones to get information, they expressed great interest but indicated that they wanted assistance in navigating the information on the internet. One respondent expressed the view that:

‘.....nurses should guide us on where to look for information on the internet.....we cannot risk the health of our unborn babies by using any information that we come across.’

Twenty of the twenty-five women interviewed said they found comfort in the company and social interaction of women in the same condition as them. They pointed out that hospitals should facilitate the coming together of women in peer groups where they could share and exchange information. One expectant woman said:

‘.....some of us are already participating in group discussions on WhatsApp, it would help us a lot if social groups for expectant women could be formed on WhatsApp.....we need people to empathize with.....’

The woman with the breeched pregnancy used her Samsung smartphone to access information and advice given to women with “breeched” babies. However, this information was often technical and would have required further clarification from a health professional. During one of her visits to Parirenyatwa hospital, she sought to have clarity on some information she had acquired from the internet – the medical professional on duty informed her that time was of essence, she could not possibly answer all the questions she had. It was a moment of clarity to her that, while she now had the technology to access antenatal information – no one was able to clarify it for her.

The expectant women were asked about the traditional ways that information is accessed. The interviewees identified health-care centres as their primary source of information. The general feeling was that the information provided by these centres could be trusted in comparison to the information that was accessed from anywhere else. One respondent explained this further by highlighting the fact that:

Interviewee:hospitals not only provides us with medicine.....they also tell us what to do to stay healthy.....when we get sick we turn to hospitals for answers, don't we?

Radios and televisions were also identified as valuable mediums from which health information can be accessed. The respondents alluded to the fact that most of the health programs delivered through these mediums would be having a health professional to offer professional insight on the topic under discussion. In their view, this gave the information provided legitimacy.

2% of the interviewees indicated that they had at one point in time got information from informal groups such as women's societies or social gatherings. One woman said:

Interviewer: Besides the hospital, where else do you get information on your health or that of your family?

Interviewee: The monthly women's network meeting at my church has a segment where we are given health tips on how to take care of ourselves and our families.....they are exciting because we almost always get to discuss tips and offer new ideas on how they can be made more effective.

Despite the high levels of education among the participants, only 39% indicated that they at one point used their cell phone to search for health information on the internet. This minimal use of mobile internet for health purposes was put in context by one participant who stated that:

.....there is a lot of information on the internet....sometimes you do not know how to find what you want.....and the conflicting information can be confusing at times.

The potential of m-Health technologies in maternal health-care should be analysed within the broader context of how women have traditionally accessed health information in Zimbabwe.

The key findings regarding access to maternal information are:

- Only a few women were using the cell phones to get more information on maternal health as they complained of too much information that is on the internet.
- Most women acknowledged that they are able to research maternal information from their cell phones but they need a health professional to explain the information to them

- Access to maternal information is mostly when the women are in the hospitals and they find the visual information easier to understand although they are mostly more focused on enduring the long queues than reading the information
- The women indicated that they need more access to maternal health information outside the hospitals and currently they rely on peer-to-peer information to comfort each other
- They are receiving maternal health information from radios and social media but they need someone with a professional insight on the topic under discussion.

4.7.4 Information Dissemination in Zimbabwe's Health Sector

A notable observation that the researcher was able to make was the strong presence of pictorial charts on the walls of the antenatal units at the two hospitals. These charts provided information to expectant women on the type of food they should eat, the light exercises they needed to do and instructions on how to take care of themselves at home. While these charts were very informative, in the fifteen days that the researcher spent at the health-care centres, there was not a single woman/expectant woman who took time to read them. The women were mostly concerned with enduring the queue to see a health professional (as part of their regular scheduled appointments) and leaving immediately thereafter.

The health-care centers did allude to the fact that due to declining budgets brought about by a shrinking economy, they had drastically reduced the giving out of pamphlets and other reading material to antenatal patients. There was now a heavy reliance on information workshops at health-care centers to disseminate information that could otherwise be distributed through printed material.

The health-care professionals were asked about their views of maternal health information dissemination. Traditional health-care information dissemination from the viewpoints of healthcare personnel (doctors and Information managers), revealed that much emphasis is being put on the health centre as the focal point from which people should have access to their information needs. One of the doctors interviewed identified the ease of aggregating information and packaging it in an understandable form as the primary reason why this was the case. The context of the doctor's response was as follows:

Interviewee: Health information in its raw form is technical, therefore it is our responsibility to explain it in person or re-package it in terms that a common person can understand.

Disseminating information through a health centre also gives us the opportunity to answer any lingering questions that patients may have based on the information we have given them.

Information managers at hospitals further pointed out that they do sometimes partner with civil society to disseminate information through awareness campaigns at schools, universities, community gathering or any social event. An information and public relations specialist that was interviewed at Harare hospital testified to the fact that newspapers and billboards remain the instruments of choice in disseminating primary health-care information. He added that:

.....with low or diminishing budgets in health-care delivery in the public health system, we have to find innovative ways of maintaining the flow of information to our citizenry while using mediums that are cheap and able to reach a wide audience at minimal expense.

4.7.5 Analysis of Health-care Information dissemination in Zimbabwe

One key finding of this study was that information dissemination in Zimbabwe's public health system remains largely prescriptive and devoid of any noticeable interaction between health service providers and patients. In a study conducted by researchers from the University of Zimbabwe on the channels used to disseminate information to HIV infected women, it was found that there was a one-way mode of communication where 'books, fact sheets, brochures, and other information products' were the default sources of information (Nhendodzashe & Nhendo 2013).

It is a reality that featured prominently in this study where 100% of the respondents expressed a need to be able to engage with health-care providers on the basis of the information provided. One of the reasons cited by health professionals on why this was the case was the lack of adequate resources from both a technological and human resource point of view – to enable an interactive exchange with their patients. Although all of the women interviewed had attained a reasonable standard of secondary education, 60% were concerned that some of the health information provided was in relatively sophisticated technical language which required further clarification to make it useful. This state of affairs presents a lost opportunity in the public health system where the potential to improve health access is hampered by the minimal use of available information by its intended recipients due to the top-down flow of information between health providers and their clients.

To further understand trends in health information dissemination in Zimbabwe, the critical question of where patients have access to this information needs to be answered. There was a universal view in which 88% of the respondents stated that they get most of the information they need from the health-care facility itself. Offsite health information access was almost non-existent. Outreach programs by civil society organizations such as the Zimbabwe Women Resource Network on reproductive or maternal health are rare and if they do happen, are mostly focused on chronic diseases like TB and HIV/AIDS. There is therefore a need to put in place cost effective measures that will allow patients to have constant access to health information from sources other than the health centre itself.

Health information dissemination within the context of health-care professionals and their relationship with their patients revealed that more could be done to enhance communication between the two parties. Of the fifteen health-care providers interviewed, 80% agreed that there was need to move beyond the culture of focusing on internal information exchange towards an outward focus on the patient. Their sentiments are a reflection of Zimbabwe's eHealth Strategy (2012 – 2017) which places greater emphasis on improving the flow of information across health-care centers across the country and between health professionals. The e-Health strategy is somehow silent on what can be done to improve the patient experience when accessing health information. While the health professionals interviewed showed a keen interest in improving the flow of information between them and their clients, the current health information operational framework still remains inward looking and biased in its view of patients as non-active participants in the health-care delivery system.

“.....most of the tips are just general....you are told that you must do light exercises, not to smoke or drink alcohol. I only find the useful part to be advice on the type of food that a pregnant woman should eat.....’

The key findings regarding maternal information dissemination are:

Dissemination of information in Zimbabwe's public health system remains largely prescriptive and devoid of any noticeable interaction between health service providers and patients, there is lack of adequate resources from both a technological and human resource point of view to enable an interactive exchange of information between health-care providers with their patients.

4.8 Maternal information needs

The information needs of the expectant women are discussed first followed by a discussion of the information needs of midwives.

4.8.1 Information needs and expectations of expectant women

Health-care centers and health-care professionals have a standard appreciation of what they perceive to be the needs of expectant women and how those needs should be met. This study, however, sought to establish from the women themselves what their needs are and the nature of support they expect both at home and from health-care service providers during their pregnancies.

From the twenty-five women interviewed, twenty-three of them said health-care providers should do more to provide offsite information to help them understand and deal with minor discomforts brought about by their pregnancies.

While hospitals do provide pregnancy counselling and hold scheduled information sessions to expectant women, the latter expected to have an opportunity to have an ongoing conversation with their health-care providers on the basis of the information provided. 60% of the interviewees argued that the time-bound information sessions are not enough for them to exhaustively interrogate all the information delivered. One of the interviewees said she has: ‘attended a fair share of these information sessions.....but they mostly involve women listening to what is being said by the nurses.....little time is left to ask questions’.

4.8.2 Information needs for health-care service providers

The service providers also expressed their concern about the type of information that they receive from the women. Information is needed for midwives to perform their core tasks and is a concern of the midwifery practice in both Harare and Parirenyatwa hospitals. They also require information to deal with specific situations such as diagnosis and the solution of specific problems related to their work at the midwifery obstetric unit.

The midwives indicated that the maternity case record (MCR) is an essential source of information which describes patient’s details and care progress. It is important for midwives to obtain and provide information on time to perform their tasks. Therefore, when a complication arises or in an emergency circumstance, midwives urgently need information to deal with this specific situation and they may also use guidelines in this case, to provide safe

care of women and babies. The most general information needs are related to patients and they can get the information from the patients but if the patients are in pain, they fail to provide adequate information. In situations like these, they will need to obtain information needed from the patient's maternity case record book, but if the patient does not have the maternity case record book, then they will not be able to access the information that they need in order for them to make appropriate decisions.

They raised a point that most of these ladies do not come for check-ups nor register in time because of transportation problems and also they cannot afford to pay \$50 for registration. They do not receive enough information from them and at the end they fail to do their proper work.

Relatedly, another health-care professional was of the opinion that the Information Departments at hospitals should be used to gather more information from patients before they leave the facility. This would help the health professionals to gain more insight into their patients' condition and suggest remedial action that could be communicated over the phone or during their next appointment.

4.8.3 Analysis of the information needs of expectant women and health-care providers

The findings relating to the maternal information needs as discussed above are as follows:

- The maternal information flows mostly one way from the health-care professionals to the expectant women with the women mostly passive recipients. There is a need to move beyond the culture of focusing on internal information exchange towards an outward focus on the patient where and when information is needed
- The more technical information needs more explaining for which there is not enough time during the consultations
- The health-care canters are the primary source for maternal health information and there is not enough budget to extend this to outside the health-care canters
- Maternal health-care information is mostly prescriptive and there is a need for more engagement around a specific information need even outside the scheduled appointments and outside the health-care centre
- The expectant women trust the maternal information available at the health centers and feel overwhelmed by the large amount of information available in the public domain that is sometimes confusing

- Health-care professionals have to rely on information in the maternity case record which may be insufficient to deal with complicated cases or when it is incomplete when expectant woman do not register at the beginning.

While most expectant women in this study expressed satisfaction with the level of support and the nature of information given by midwives during their pregnancy, there was an underlying feeling that more support could be given. One respondent narrated that in her first pregnancy, as her body changed, due to physical symptoms of nausea and fatigue – she wished she could access information that could explain in detail what was happening to her. This feeling of despondency was further compounded by the health-care professionals who just dismissed her concerns as ‘just normal occurrences for all expectant women’. In fact, 80% of the respondents alluded to the fact that most antenatal health-care professionals are not patient when it comes to answering questions from expectant women. The respondents argued that the nurses were more concerned about the number of women they could examine at any given time and dismiss rather than the quality of information they provided. It was not surprising therefore to observe the unanimous approval for a mobile health information service that could help them understand the development of their pregnancies.

4.9 The prevalence of ICT use in Zimbabwe’s Health System

The use of ICT in Zimbabwe’s maternal health-care service provision is discussed next. The services offered by Zimbabwe’s maternal health system are structured in such a manner that their provision is almost the same across the country’s health centres. Pregnant women are required to register their pregnancies early so that they are entered on a maternal monitoring programme to track the development and progress of their pregnancies. Parirenyatwa and Harare hospitals provide a holistic approach to maternal health-care by providing access to education and information, safe and effective contraception, community and family support, as well as access to quality health-care.

4.9.1 Experiences of expectant women in the use of ICTs to access information

The use of Information and Communication Technologies (ICTs) by health-care centres and health professionals to interface with patients is in its relative infancy in Zimbabwe. The responses provided by the interviewees pointed to a traditional form of information exchange between the three afore-mentioned parties. There was still heavy reliance on pamphlets,

information sessions and inter-personal communication. A respondent at Parirenyatwa hospital attested to the fact that:

‘.....the only time I have had a close interaction with technology at the hospital is when my (biographical) details are being captured (by administration staff) on the computer or when I go for a scan to know if everything is okay with my baby.’

When asked the same question, one of the expectant women said:

‘.....since when I became pregnant, my only experience with a communication technology tool has been the phone (laughs).....I don’t know if that counts. I had somehow lost my appointment card and I wanted to know when my next appointment would be, so I called the hospital. As with all public facilities in this country, no one answered the call. I had to make an unscheduled trip to the hospital the following day to get assistance.’

All the women interviewed were unanimous in their view that their experience could be enhanced if health-care centres could take advantage of mobile phones to provide health tips to patients and assist them get medical advice without leaving their homes. One respondent argued that one of the reasons why health professionals are sometimes ‘grumpy’ is because they are overworked, mostly by attending to cases which they can diagnose and recommend prescriptions over the phone during their breaks.

As discussed in earlier sections of this analysis, an anomaly that was confirmed by the interviewees is that there has been little effort on the part of government and health-care centres to incorporate technology that could enhance interaction between professionals and patients. Much emphasis has been placed on In-house technology use and adoption.

4.9.2 Use of ICTs by health-care centres in information dissemination

One interviewee who heads the Health Information Management Unit at Harare Hospital stated from the outset that:

‘.....despite tentative efforts to embrace ICTs in the country’s health sector, let there be no mistake, the sector is still making extensive use of paper-based medical records’.

It’s an admission which partly explains why the ‘ICT Revolution’ in the health sector has started from within the health-care centres themselves and not the patients. There is need, as the above-mentioned interviewee further added, ‘to strengthen the technological capacity of

health-care centers, by integrating its operational processes so that they can be able to build towards a technology-driven patient experience in future’.

On how communication between pregnant women and health-care centres could be enhanced through mobile technologies, the IT personnel at both Parirenyatwa and Harare hospitals agreed that not much is being done to take advantage of the country’s high level of mobile penetration. One staff made reference to regional examples where:

‘...hospitals and clinics in Uganda’s Jinja district are now sending messages to mobile phones of women (and their partners) encouraging them to honour appointments.’

Zimbabwe’s e-Health strategy outlines the country’s strategic plans to expand the adoption of ICTs and help streamline the nature and level of contact between health-care centers and citizens. However, as confirmed by both doctors and IT personnel at the two hospitals under study, the country’s current economic difficulties have hampered efforts to roll out some of the recommendations in the e-Health Strategy. One doctor from Parirenyatwa hospital contextualized this view when he said:

‘.....the government spends 8% of the country’s miniscule national budget on health. In comparison with other countries in the Southern Africa region, we are the lowest spenders on health and this impact negatively on programmes such as ICT development in the health sector’.

The interviewee further added that Zimbabwe’s private health sector has made use of various health ICT instruments to provide quality health-care for individuals who use their services. However, not everyone can afford private health-care. A disproportionate amount of people continue to use the public health system as it is cheaper, despite the host of challenges it faces.

4.9.3 Analysis on the Prevalence of ICT use in Zimbabwe’s Public Health System

Zimbabwe has a general National ICT Strategy in place that seeks to provide strategic direction on the adoption and use of ICTs across sectors such as health, education, the economy, telecommunications and environmental management among others. Of particular note and significance to this study is that the strategy aspires to ‘increase Zimbabwe’s mobile density by 10% every year’ while ‘promoting innovative locally developed applications and technology solutions’. The country’s e-health strategy is premised on the national ICT

strategy where it seeks to ensure ‘that the right health information is provided to the right person at the right place and time in a secure, electronic form for the purpose of optimizing the quality and efficiency of health-care delivery’.

Health-care professionals and interviewed for this study indicate that ICT use in the health sector is still focused on in-house information requirements of healthcare professionals rather than on patients. They attested to the fact that procurement of ICT products is primarily aimed at strengthening electronic medical record systems to track individual patient records, population level database applications and medical education research services. When it came to the provision of telemedicine services (which is the use of medical information exchanged from one site to another via electronic communications to improve patients’ health status), the health-care professionals and ICT personnel were in agreement with the view expressed by expectant women that there were inadequate systems in place to adopt this approach. Health professionals were unanimous in their view that the proliferation of smart phones among most expectant women presented an opportunity to expand the framework with which health-care centres could enhance pregnancy surveillance and monitoring, assist patients with a helpline and give patients access to information repositories housing their health data.

Expectant women, as is the case with other patients in Zimbabwe, have limited encounters with health-related ICTs during the course of their pregnancies. One respondent stated that while she often uses the internet to access antenatal information, she is concerned that some of the websites she visits might not be approved sources of information. Relatedly a woman at Harare hospital, who once lived in South Africa briefly, decried the absence of internet enabled information help desks manned by nursing assistants to help expectant women – a feature she witnessed when she visited Chris Hani Academic Hospital in Johannesburg. The general feeling among respondents was that health-care centres should take it upon themselves to help organize the flow of information to personalized and versatile devices such as mobile phones, give scheduled short message instructions on where they could find information and provide updates on their next appointments. The findings relating to the prevalence of ICT use in Zimbabwe’s public health system are:

The findings relating to the use of ICT in maternal health-care services in Zimbabwe in the two cases are:

- The two hospitals have a good ICT infrastructure but it is not yet used for patient data, apart from capturing their personal details, or to engage with patients - information is still paper-based
- The expectant women feel that technology has the potential to improve their engagement with health-care professionals and to access information when needed
- The government's e-strategy indicates the plan to utilize technology and especially mobile technology to improve health-care services to patients but in practice the lack of resources prevents this and the focus remains on internal ICT use.

4.10 Mobile Technology use in the maternal health sector in Zimbabwe

In this sub section the role of mobile technology in maternal health-care services in Zimbabwe is considered. It is firstly considered in terms of the current use and then how it could be used.

4.10.1 Use of mobile phones for general health information needs by women in Zimbabwe

The researcher asked the interviewees on the amount of time they spent on their mobile phones and this time was averaged to give an aggregate amount. On a typical day, the average woman in the control group (interviewees) spends a cumulative four and a-half-hours on their phone. A disproportionate amount of this time is spent on social networking, with limited amounts spent on information search.

Two respondents admitted to using the health tips SMS service offered by a local mobile service provider, Econet wireless. It is a generic service that offers health tips to specific target groups – expectant women being one of them. When one of the respondents was asked if she would recommend the service to other expectant women, she had this to say:

“.....most of the tips are just general....you are told that you must do light exercises, not to smoke or drink alcohol. I only find the useful part to be advice on the type of food that a pregnant woman should eat.....’

The use of smartphones to access general health information was limited, with only two women admitting to having used it once to get health information on the internet and one stating that she is a regular user of mobile internet for information purposes. The former (two

women) found the experience ‘okay’ but one of them claimed the information overload was ‘very unhelpful’.

In recent times, it has become permissible (according to the expectant women interviewed in this study) to have the image of the infant taken during a scan sent to the women’s email address or downloaded to a memory stick. This is to give parents “a chronology” (as one woman put it) of how their child was growing during the different stages of its development. One woman who makes use of the email address-mobile internet option says having these images on her phone helps her to start having a bonding process with her child even before it’s born. Mobile phones have thus provided a window of opportunity for pregnant women to have access to antenatal information that they previously had no access to.

4.10.2 Use of Mobile Health Technologies in Zimbabwe’s health system

Despite the wider adoption of mHealth technologies in much of sub-Saharan, the researcher was not able to witness any notable use of mobile health technologies at Parirenyatwa and Harare hospitals.

However, the medical doctors that were interviewed in this study agreed to use mobile technology for medical research to assist them in their medical profession. One of the doctors interviewed explained:

‘..the portability of mobile devices give us the flexibility to access information without having to go to fixed specific locations like a desktop. Mobile phones have also enhanced the interconnectedness of medical professionals as we are able to exchange information in real time, especially for complex and critical medical conditions’.

When the researcher sought to establish why mHealth technologies were not being adopted to improve communication between health-care centres and patients, an IT professional at Parirenyatwa hospital said:

‘.....I think there is no will from those tasked with health delivery in Zimbabwe. The constant refrain is that budgets are very low but the infrastructure costs of setting up a simple SMS notification system are negligible. We need people who can make the brave decisions to set the ball rolling in improving service delivery in the health sector.’

Mobile phones have nonetheless been instrumental in helping health-care centres improve communication between them and their patients. In cases where a patient is admitted and

their condition requires consent for an operation from a relative hospitals are now able to make calls and arrive at critical decisions in real time.

While medical personnel expressed support for the use of mobile technology in the flow of information, they were reluctant about giving their mobile numbers to patients who might need medical advice beyond the regular appointment schedule. Another doctor advocated for an alternative where:

“.....the hospital should take the responsibility to dispense information to the patient’s mobile devices. As professionals, we can play our part on the type of information that is disseminated depending on the health condition of a given patient. Patients should also be able to air their views or concerns on the information received,”

4.10.3 Analysis of Mobile Technology use in the maternal health sector in Zimbabwe

TechZim, an online information technology blog, is of the view that Zimbabwe’s current mobile penetration stands at 87%. This figure, it adds, is based on the number of active sim cards in the country.

Of the 15 women interviewed in this study, 13 had smartphones that were internet enabled. It was however rather telling to note that only 9% of those who had smartphones used them to obtain information from the internet. The most prevalent use of the smartphones was for social messaging application WhatsApp or social networking site Facebook. For those who used their phones to obtain information online, only 1% used them to search for health-related information. Most respondents were surprised on the amount of antenatal information that they can access online through their phones when the researcher gave them a demonstration. There is a clear need not only to incorporate mobile phone technologies in antenatal health delivery but also to conduct information literacy sessions with expectant women on how to use their phones to access information.

The mobile telephone company, Econet Wireless, currently provides a paid mHealth service to its subscribers that involves providing health tips on diet, how to manage diseases such as diabetes and health tips for expectant women. While the service costs US\$0.05/day (R0.65), 50% of the interviewees argued that in a depressed economy such as that of Zimbabwe where unemployment stands at 80%, they would rather spend their meagre incomes they have on meeting their food requirements rather than on a subscription SMS service. When the researcher asked the relevant IT personnel at Harare and Parirenyatwa Hospitals on why there

wasn't a free mHealth service for expectant women, they cited the unavailability of resources at both human and technological levels as the reason why they could not pioneer it. Under these circumstances, the use of email can be used as the default mode of communication but interview data reveals that only 40% of expectant women are active users of emails.

The findings relating to the mobile technology use in the maternal health sector in Zimbabwe are:

The findings about the use of mobile technologies in maternal health-care services are:

- There is a high penetration of mobile technologies in Zimbabwe and both the healthcare professionals and expectant women see the benefit of using these technologies
- Health-care professionals indicate that the mobile technologies will provide them with the freedom to seek for assistance when and where needed
- The expectant women feel that the use of mobile technologies can add value to their pregnancy experiences but then with relevant information
- There are some examples of where health-care centres are using mobile technology to engage with patients, e.g. to get the consent for an operation from a relative but this is not a common situation
- Health-care professionals are reluctant to give their numbers to patients
- Expectant women mostly used their mobile phones for social purposes and lack the literacy level to seek for the right information for a specific purpose
- The available m-health services are too expensive for the expectant women who need money for their basic needs.

4.11 Interpretation of research findings

This section outlines the interpretation of the research findings derived from the primary data gathered through interviews between the researcher and the respondents. The interpretation of these findings is guided by this study's main research question and the identified research objectives.

4.11.1 Maternal Health-care Facilities

Health-care services are provided to the people of Zimbabwe at rural health-care centers, hospitals and urban clinics with three levels of referrals to district hospitals, provincial and

general hospitals and central and special hospitals. The need for health-care services in rural under-served areas is provided by mission hospitals and NGOs. Most of Zimbabwe citizens (60%) live within 5 km radius to the nearest health-care facility and only 17% within 10 km radius. Access to health-care facilities is sufficient but many of the facilities are under-resourced due to the loss of skilled health-care professionals and declining budgets.

4.11.2 Maternal Health-care Services

The maternal health-care services in Zimbabwe for this study seem to be adequate in the hospitals but these services are not available outside the hospital. This means that pregnant women can only access maternal services at the health-care facilities and if they need antenatal, postnatal or emergency obstetrics care or family planning services they cannot be assisted. The findings indicate the need to extend maternal health-care services to cover the entire pregnancy similar to Graham, Binns & Munjanja (2013) suggestions that key interventions at the appropriate time could improve maternal health-care services.

Zimbabwe has a cash-strapped and impoverished economy with the loss of many skilled health-care professionals resulting in a difficulty for the government to implement a health-care strategy to address the challenges of health-care service provision. Free health-care services provision is no longer viable resulting in the introduction of user fees in an ad hoc manner that affects the affordability of such services by poor and vulnerable people. The much needed extension of services to outside health-care facilities therefore seems to be not viable at this stage. This could explain the reasons why scheduled appointments are not always kept. The issue of complications during pregnancy can therefore not be addressed that will remain a concern (Wagstaff & Claeson, 2004; Nour, 2008; Hunt & Bueno, 2007; Huda et al. 2012).

Furthermore, health reform aligned to the global trend with an investment in ICT to facilitate the services is hampered by a lack of coordination among the policy makers and different and health-care service stakeholders who operate as autonomous bodies (WHO, 2010). Maternal health-care services in Zimbabwe will remain insufficient to address the challenges associated with maternal health-care experienced in developing contexts. Zimbabwe's maternal health-care services are affected by challenges similar to growing populations and rising health-care costs and they have not been able to sufficiently address the risk of complications that occur outside hospitals that could result in unnecessary deaths. This

confirm the concern raised by Ali et al. (2011) that progress has been slow to reduce maternal mortality in response to the Million Development Goal.

4.11.3 Maternal Health Information

In this instance, the researcher wanted to focus attention on what women consider to be relevant information that can help them manage their pregnancies better. Relatedly, the study also endeavored to locate the role of midwives within the information exchange matrix by determining the kind of information that they need to help expectant women during their pregnancy.

It is a generally accepted antenatal rule that expectant women should be monitored regularly during the course of their pregnancy through regular appointments. However, there are certain instances where they have to make unscheduled visits to the hospital to obtain information or medication to deal with discomfort – an occurrence which was mostly prevalent in expectant women interviewed for this study. They nonetheless argued that these unscheduled visits tend to lead to long queues, further aggravating their discomfort. There was therefore universal agreement among the respondents that health-care providers should invest more in offsite information assistance mechanisms to help them cut back on unscheduled visits. Remote patient monitoring has the potential of improving health outcomes and increasing access to treatment or care (Vital Wave Consulting 2009: 14). The respondents further pointed out, should remote information provision be availed, they need to have an interactive relationship with health-care providers on the basis of the information provided.

4.11.4 Maternal Health Records

The maternal health record is an important instrument to record all the information relating to the pregnant woman's pregnancy and is used by all the health-care stakeholders involved in providing maternal health-care services. It is still a paper-based record and although data recording and retrieving of the record when needed are still tedious and time-consuming it contains all the necessary information about the pregnancy. The coding and classification system is relatively efficient (DoH, 1997). The MHR facilitates communication across the maternal health service delivery chain (Stausberg et.al, 2003). The current paper-based MHR seems to be sufficient for its purpose.

4.11.5 Maternal Information Flows

The Maternal Case Record (MCR) is used to manage the maternal health-care services to the pregnant woman by the different health-care professionals at the different health-care facilities. It is an important communication tool to be used by the different health-care professionals. The MCR is kept at the health-care facility but is sent with the patients in the case of referrals. The pregnant woman's information flows upwards through the referral system but the feedback is only captured in the MCR. The MHRs only flow between the health facilities and not to the home of the pregnant woman.

4.11.6 Access to Maternal Information

Pregnant women need information about the pregnancies and potential risks and although they have access to the information outside the hospitals they need the health-care professionals to explain it to them. This means that the value of the information is mostly achieved at the facility and this is often not possible when the health-care professionals do not have sufficient time to answer questions during consultations. The only access to relevant maternal information outside the hospitals is mostly from their peers or family members and general information on the radio. Some pregnant women access maternal information on the internet but feel overwhelmed by the volume of information. Pregnant women need access to information relevant to their situation and do not currently find it easy to access such information. This results in them feeling anxious about their pregnancies and potential risks may not be identified in time.

4.11.7 Maternal Information Needs

Pregnant women in Zimbabwe are passive recipients of maternal health information and mostly during visits to the health facilities. However, they need maternal health information pertaining to their needs when they need it with access to a professional to explain it and answer their questions. There is insufficient budget to extend the maternal health-care services to beyond the health facilities to provide relevant maternal health information services that allows for interactions around specific maternal health topics. It is important to deal with the information needs as part of the maternal health-care services to support the relationship between the pregnant women and health-care professionals (Rabor, Taghipour & Najmabadi, 2015).

4.11.8 Information Dissemination in Zimbabwe's Health Sector

The data collected under this theme sought to establish the general trends in the dissemination of information in Zimbabwe's health sector, the demographic profile of the women interviewed for this study and the views of health-care professionals on health-care information dissemination in Zimbabwe.

4.11.9 Health-care Facilities as Primary Source of Information

The fact that all respondents identified health-care centers as their primary source for health-related information indicates the leading role that these centers should take in adopting tools such as mHealth technologies. Their unique position is as a result of the high level of trust that patients have in acquiring information from them in comparison to random sources. Ganapathy & Ravindra (2008) posit that hospitals have fairly good systems in place that hold detailed biographical details of patients, which can allow them to create target groups (based on ailment) for information dissemination purposes.

4.11.10 Expectations of midwives

“Interaction between women and midwives has an important role in midwifery care and midwives have a key role in such interactions. Therefore, it is important to know how interactions between midwives and women are formed (Rabor et.al 2015). The midwives interviewed for this study expressed concern that some expectant women register late for regular observation. This is of concern to them because they will now be expected to deviate from their normal schedules in order to keep a constant eye on these late registrations. Limited resources, however, often pose a serious challenge to this endeavor. The researcher was able to conclude that remote information sharing between expectant women and midwives can be a useful instrument in overcoming this challenge. Women should be able to send information to health-care centers on the state of their health, from which health professionals can then respond with health advice. Information departments at hospitals can help in this regard by gathering as much information as they can about patients in order to help midwives interact knowledgeably (through remote means) with expectant women.

4.11.11 Cost of Access to Information

90% of the women were married but the general economic circumstances of all the interviews revealed that they either relied on their partners for sustenance or were heavily involved in

informal trading. Zimbabwe's dire economic situation, where it is estimated that 90% of the population (The Standard, 2014) is unemployed, partly explains this subsistence living by the interviewees. The general economic circumstances of individuals have been found to influence how they access information. In most cases they tend to gravitate towards cheaper sources of information where they don't have to spend their meager income.

4.11.12 How antenatal information should be delivered

While this study was able to establish that hospitals are the primary sources of health information for expectant women, the latter also expressed an interest in how the information was delivered. The researcher was able to establish that the huge amount of text contained in information pamphlets was sometimes a hindrance that limited its usefulness to its intended recipients. The respondents stated that information presented in pictorial form was always engaging – a characteristic that helped them to understand it better. One respondent went further to say that, with social media applications, pictures and pictorial diagrams can be sent on mobile phones therefore health-care centers should explore ways of how they can make use of this medium to communicate with them.

4.11.13 Information Literacy Training

The average age of the fifteen women interviewed was 30 years and 73% of them had gone on to acquire a post-secondary education. As the respondents would reveal later in the interview process that they would welcome information literacy training on mobile information use, their favorable educational backgrounds indicate that they would be quick to adapt and use the information presented to them on this subject. Measure evaluation (2010), an impact assessment organization in South Africa, found that the widespread success of "MomConnect" (an MHealth application for expectant women) was due to the training provided to expectant women on the use of the application.

4.11.14 Use of Feature Phones and Smartphones

Despite obtaining post-secondary education, only 39% of the interviewed women admitted to having used their cellphones to search for health information on the internet. 'Information overload' was identified as the primary reason for this low uptake. There must therefore be ways where maternal health information should be repackaged and made available in its simplest form to expectant women. South Africa's MomConnect has been successful in this

regard, particularly with regards to the fact that it has started to incorporate a few of South Africa's official languages in its information dissemination programmes.

A significant characteristic which defined the interviewees was their possession of feature phones and smartphones. These two types of phones are enabled to access the internet and facilitate social messaging through applications such as 'Whatsapp', 'Facebook' or 'twitter'. The inability of Zimbabwe's health system to take advantage of this second and third generation handset proliferation illustrates a lost opportunity. All the women interviewed were habitual users of the social networking application 'WhatsApp' which allows the creation of custom-made groups. Antenatal centers could leverage on this tool to broadcast messages to women falling within a particular period of pregnancy development.

4.11.15 Emphasis by Health-care centres on Internal IT Adoption

The information technology professionals interviewed at both Harare and Parirenyatwa hospitals admitted the adoption of IT was largely for in-house use to manage the administrative and operation needs of health-care centers. It is a view that is reflected clearly in the country's e-Health Strategy where emphasis is placed on integrated systems to manage information flow between health-care centers and health professionals. The strategy is silent on the role of the patient in the information matrix. There was however a universal acknowledgement that m-Health could open up new opportunities to help health professionals to communicate more effectively with patients on an off-site basis.

4.11.16 The prevalence of ICT use in Zimbabwe's Health System

The adoption of mHealth Technologies in Zimbabwe's Health sector is contingent upon the prevalence of general ICT use in the health system. This segment looked at what, if any, are the prevailing ICT tools being used in the antenatal health sector for both patients and professionals.

4.11.17 Low adoption of ICTs to enhance patient experience

The interviewees were unanimous in their admission that there was limited use of ICTs in the country's health-care centers to enhance user experience. There was an over-reliance on traditional forms of communication such as pamphlets, information sessions and inter-personal communication. The only evidence patients had come close to an information technology instrument was when their biographical details were being captured on a

computer or when they underwent a scan to verify the health of the unborn child. Communication with patients beyond the walls of the hospital was almost non-existent. Despite Zimbabwe having a national ICT strategy which seeks to “increase Zimbabwe’s mobile density by 10% every year” while ‘promoting innovative locally developed applications and technology solutions’ – this aspiration has not translated into a notable contribution to improve communication and information flow in the health sector.

4.11.18 Over-emphasis on internal ICT use by health-care centers

Zimbabwe’s national Department of Health and Child Welfare was making tentative efforts to invest in facilitating connectivity between and within health-care centers (including health professionals). An information management professional at Harare hospital indicated that this is a deliberate policy focus whereupon it is envisaged that a strong internal ICT structure will result in an organic development of a technology driven patient-user experience. The veracity of this policy position is however found wanting in the sense that, the setup costs of SMS (short message service) infrastructure was negligible when viewed against the benefits that accrue from constant engagement with patients. This is evident in Uganda’s Jinja district where hospitals and clinics have registered considerable success in the SMS service that they use to remind women (and their partners) to honor hospital appointments.

4.11.19 Mobile Technology use in Zimbabwe’s Maternal Health Sector

In order to get a balanced view on what needs to be done to facilitate mHealth adoption in Zimbabwe, this section looked at the relationship habits of expectant women and their mobile phones. It also went further to ascertain the prevailing trends in mobile technology use by health professionals.

4.11.20 Mobile use habits among expectant women

There was high mobile phone usage among the interviewees with the average user spending a cumulative average of four and half hours on their phones. Since most of this time is spent on social networking sites, health-care centers and professionals have been presented with a unique opportunity to broadcast medical advice to a wide audience in real time through these platforms. Such an approach will help to mitigate the current trend where only 9% of the respondents use their phones to search for health information on the internet. This research was able to establish that while there is an interest to obtain health information on the internet, there is need for guidance on how and where to look for information.

4.11.21 Institutional bias in mHealth technology use

Consistent with their deliberate inward focus on ICT development, health-care centres and professionals have embraced mHealth for their own professional processes rather than patient interaction. As one medical doctor noted, mobile devices have given them the flexibility to access information without having to go to a desktop and it has also enhanced interconnectedness of medical professionals as they are now able to exchange information in real time, especially on complex and critical medical conditions. While this is of significant importance to the health delivery system, it does not give patients the opportunity to become active participants but rather passive consumers of information. Institutional bias in ICT and mHealth use can easily be identified as one of the reasons why generic ailments which could be diagnosed remotely – form part of the traffic that descends on under equipped health-care centres to get treatment.

Recommendations

Recommendations for mHealth use in Zimbabwe's antenatal health sector

- The recommendations for mHealth use in Zimbabwe's antenatal health sector include:
- In order to overcome limited budgets, health-care centers can begin by using simple information sharing mobile applications such as WhatsApp, Facebook, Twitter or SMS.
- Information literacy training on mHealth technology use, for both health-care professionals and patients, should be a priority for health-care policy makers when implementing the national health-care information strategy.
- Hospitals need to start packaging general health pregnancy information for onward broadcast to expectant women while at the same time encouraging the latter to submit any questions that they may have on the information delivered.
- Zimbabwe's national health budget, especially as it pertains to technology adoption, remains miniscule when compared to other countries in the SADC region. The government needs to realize that investing in areas such as mHealth technologies can relieve the workload of health professionals over time through the reduction of congestion at hospitals.

Hospitals need to become perpetual learning organizations on mHealth technology use. MHealth is already being used to good effect by countries such as South Africa.

4.11 Conclusion

The aim of this study was to explore and exploit the potential of mHealth technologies for maternal healthcare services in Zimbabwe's public hospitals' maternal units. This chapter focused on the analysis and interpretation of the research findings. Content analysis of the interview responses and the thematic paradigm was used for analysing the findings. The results derived from the analysis of the research findings were aggregated through the following thematic areas:

- Trends in information dissemination in Zimbabwe's Public Health System
- Information needs for expectant women and midwives
- The prevalence of ICT use in Zimbabwe's Public Health System
- Mobile Technology use in the maternal health sector in Zimbabwe

CHAPTER 5: Conclusions, Reflections and Further Research

5.1 Introduction

This research study explored the potential of Mobile Health Technologies in improving the efficiency of Zimbabwe's maternal health sector, with particular focus on Parirenyatwa and Harare hospitals. The basis of this chapter therefore, will be to provide a summary of the preceding chapters; explain the conclusions reached and their relationship with the problem statement. As a qualitative study that made extensive use of semi-structured interviews and observation to gather primary data from the target groups, the information gathered was collated, described and analysed to respond to the research objectives of this study. The target groups interviewed for this study include expectant women and health professionals. Using the thematic analysis paradigm to analyse the data collected, four themes were identified and were deliberated on briefly. The chapter will go further to discuss the limitations of the study including recommendations for further inquiry.

5.2 Revisiting Research Questions and Objectives

Under this sub-heading, the research will provide an outline of how the research question and the research sub-questions were answered within the context of the stated research objectives.

| Research Question | | |
|---|--|--|
| Sub Questions | Research Method(s) | Objectives |
| What factors influence maternal health-care service provision in a developing context? | Literature analysis, interviews, user experiences, user journeys | Outline factors that currently influence maternal health-care services in a developing context. |
| What are the pressure points of maternal health-care services as experienced by the pregnant women and health-care professionals? | Literature analysis, interviews, user experiences | Determine the pressure points of the maternal health-care services. |
| How can the different aspects of the maternal health-care service path be improved with the use of mobile technology? | Literature analysis, interviews | Identify the possible uses of mobile technology to facilitate maternal health services as experienced by the users |
| What are the issues contributing to the low adoption of mHealth in maternal health service provision? | Literature analysis | To ascertain the obstacles to mHealth use in Zimbabwe's maternal health sector and whether existing technologies in other countries can be used to overcome these. |

5.2.1 Research Sub-question 1

In order to have a clear understanding of the general operating environment of the maternal health sector in the developing world, the first question (sought to define the factors characterizing the state of this sector. The objective of this approach was to situate the Zimbabwean context within the broader developing world experience. To obtain answers on the afore-mentioned factors, the questionnaires for both the expectant women and the health professionals had questions asking for input on maternal health experiences from both a user and professional point of view. The analysis from non-governmental health service providers and Zimbabwe's Ministry of Health provided further insight on some of the issues currently confronting the existence of an effective maternal health sector in Zimbabwe.

The factors influencing maternal health-care service provision in a developing context are the inequity of access to under-resourced basic health-care services that leads to high mortality rate. The government's attempt to address health reform but do not have the resources and integrated view by the different stakeholders to implement the e-health strategies aligned to the millennium development goals. The poor economy and high poverty rates impact the health-care services negatively resulting in limited out-of-hospital services to deal with health promotion and disease prevention. These factors lead to an increase in complications with pregnancies resulting in high mortality rates of pregnant women and new born babies. The governments of developing countries know what is needed to improve basic health-care services but do not have the means to address this need. The high mortality rates amongst pregnant women and new born babies remain unacceptably high due to the factors affecting maternal health-care services in a developing context.

5.2.2 Research sub question 2

The inquiry managed to learn that expectant women expect more off-site support, maternal literacy sessions for expectant women, rapid turnaround time when they visited health centers and delivery of information in pictorial images that were easy to understand. Health professionals on the other hand expressed concern on inadequate human and equipment resources, which put a strain on the quality of service that they render to expectant women.

The pressure points of the service as experienced by the pregnant women and health-care professionals are: long waiting times before consultations; insufficient time during the consultations to deal with concerns raised by the pregnant women; the focus on clinical health-care services care rather than a patient-centric health-care service that will focus on the

needs of pregnant women during their entire pregnancy; lack of access to relevant information when needed; information disseminated may not be relevant and may not reach the pregnant women in a manner that is useful to them; limited health-care services outside the facilities and during emergencies; the lack of utilizing ICT, and specifically mHealth to address the needs of pregnant women.

5.2.3 Research sub question 3

The objective of the third research question was to ascertain whether there were any sections in the maternal health-care value-chain system that could benefit from the use of mobile technology. In order to answer this question, it was essential that a landscape model be made to provide a holistic picture of how expectant women, maternal health centers and professionals interact from the moment of conception to birth. The landscape model did show that it is mandatory that women should register early when they fall pregnant; expectant women make unscheduled trips to health centers when they experienced minor discomforts (using their mobile phones they can phone in for general medical advice); the health center was the only source for primary health-care for expectant women (information literacy sessions could be held to assist women to access information on their mobile internet). Health professionals were shown to have interest in having reminders sent to expectant women for them to honor their appointments (an expectation that can be met through the mobile phones short messaging service – SMS). The four thematic parameters that emerged from this study provide recurring pointers of where mobile phones can add value to the maternal health-care value chain system.

5.2.4 Research sub question 4

The efficacy of mobile health technologies in bridging the health divide in developing countries is well documented but its slow adoption is a matter that needs further interrogation. It is for this reason that the fourth research sub-question endeavored to look at the factors that are hindering the adoption of mHealth in Zimbabwe's maternal health sector. The purpose of this question was to establish potential opportunities that may exist in overcoming these challenges, especially from mHealth technologies already being used in other countries. The health administrators at Harare and Parirenyatwa hospitals were unanimous in their response to interview questions that underinvestment by government in health-care, as a %age of GDP, was the primary reason why mHealth remained in its infancy. The interviewed expectant women on the other hand showed that they were not adequately prepared to use their phones to access information on their mobile internet. This betrayed a

lack of adequate information literacy training workshops by health-care centers to their patients.

The use of mHealth in the health-care sector is not to do away with the established norms of practice but its objective is to ensure that work processes are done better and more efficiently. In this regard, research sub-question 4 wanted to identify those factors in the health sector that could be harnessed to ensure the adoption of mHealth in the maternal health sector. There is a commitment at policy level by government, through its National Health Strategy, to ensure that mHealth becomes part of the infrastructure to close the health divide. The interviewed women showed an eagerness to use mobile phones to find answers on common health ailments. They even showed their willingness to be trained on how to do so. The health administrators shared the common view that health centers need to move from their institution-centric approach to technology use and start looking at e-tools that could help them interact better with their patients.

5.2.5 Main research question

The main research question for this study was: How can mHealth applications and technologies help improve maternal care services in a developing context? The explanations provided for in the research sub-questions give guidance to how this question was answered. The response is a three-part submission that encompasses users (expectant women), health-care professionals (doctors, midwives and nurses) and health-care authorities (policy makers, government bodies and non-government bodies).

The expectant women interviewed for this study indicated that mobile phones could be essential tools to cut unscheduled visits to health centers resulting from minor health discomforts. The reasoning was that their bodies react differently to pregnancies and this may result in unscheduled visits to the hospital to get information about what they need to do to overcome the discomfort. Instead, this information could be acquired over the phone. Relatedly, expectant women wanted to have continuous real time engagement with their health-care givers. Their argument is that the time-bound sessions were not enough for them to exhaustively interrogate all the information given to them. Furthermore, the interviewees expressed a preference in having the information given to them presented in pictorial form. A recurrent theme which emerged from the responses gathered from expectant women was that

they wanted information literacy training in how to access health information over mobile internet.

The midwives expressed concern on the limited interaction that they have with expectant women beyond the regular check-ups and the day of delivery. They stated that some pregnancies require constant monitoring over and above the regular monitoring. The requirement is particularly more urgent for women who register their pregnancies late. Mobile phones could overcome these challenges by ensuring that information is dispatched timeously between the two parties.

The health-care authorities already have suitable strategies in place and the problems are associated with the implementation of these strategies that is affected by socio-economic factors that are outside their control. They can regard their services from a service design perspective to identify the pressure points and consider the use of mobile technologies at these points to improve the service delivery and increased a positive user experience of the service provider and service recipient (pregnant women).

The current health-care services can be extended to also include health information services to compliment the current services that focus more on the clinical care of the pregnant women. By supporting the interactions between health-care professionals and pregnant women with suitable technology where appropriate the relationship between them would improve with a focus on the entire pregnancy journey. The services could also be extended to include the activities outside the health-care facilities. By extending the services to outside the health-care facilities to also include health promotion, disease prevention, as well as ante, post and emergency natal care activities the delivery to the pregnant women in Zimbabwe could be improved to ultimately address the mortality issue.

5.3 Trends in mHealth use and Barriers to Adoption

The study was able to reveal that with the high proliferation of smartphones among the women respondents, there was not an active culture of using them to access health related information on the internet. Health-care centers remained the primary source of information for this purpose. Smartphones were commonly being used for engagement on social media platforms such as Facebook, WhatsApp and Twitter. The women, including the health professionals, did express their concern that health-care centers had not been able to take advantage of this medium of communication to maintain an active virtual information

dissemination service. They further added that they were willing to use their mobile phones to access health information if they were trained by the health-care centers.

The doctors interviewed for this study explained that, the role of health-care centers as primary distributors of health information can be improved by embracing mHealth technologies as another mode of distribution. Citing declining budgets in the health sector, health professionals argued that they have to find innovative ways of maintaining the flow of information to patients while using mediums that are cheap and able to reach a wide audience at minimal expense. They alluded to the fact that ICTs have to move away from their current bias toward in-house use towards a more active engagement with their patients. mHealth could allow the better use of health-care resources through remote consultation thereby allowing patients to receive health-care from their locations it mitigates the hardships due to travel requirements in resource limited settings As the relationship between midwives and expectant women has evolved beyond a once-off encounter on delivery day, the former revealed that they wanted continuous interaction with their patients beyond the regular check-ups - pointing to the unique challenges that each pregnancy faces. This was particularly true for women who registered late for their antenatal care or who failed to show up for appointments. mHealth technologies could play an integral role in providing a platform for regular interaction between these two parties. As pregnancies evolve and new challenges emerge, midwives could (through mobile technologies) diagnose their severity and determine whether a patient needed to make an unscheduled visit to a health center.

Information literacy training emerged as a recurrent theme among the women who were interviewed when prompted on whether they would use mobile phones for health related purposes. Health-care centers could hold information sessions where women were trained on how to use mobile internet to look for information and the specific sites that they should visit. Despite the relatively good levels of education among respondents, the huge amount of information on the internet can be overwhelming and hence lose its usefulness to its intended recipients. It is therefore important for health-care centers to provide directions to their patients on how to navigate this information superhighway.

Despite having a National ICT strategy that realizes the importance of mHealth technologies in health-care delivery, the practical actualization of this realization has been limited. The deliberate in-ward focus in ICT adoption can however prove to be a significant platform

when health-care centers eventually start working towards a technology-driven patient experience in future.

5.3.1 The potential of mHealth in antenatal health delivery

The general function of an antenatal health facility as portrayed in the preceding subsections, gave a clear illustration of the possible areas where mHealth could be made useful.

5.3.1.1 Knowledge-based antenatal health service

As expectant women were now using their smartphones to access information on the internet but were limited in their ability to understand all the technical information presented therein, health professionals could use this opportunity drive a knowledge-based antenatal health services. These professionals can identify information resources on the internet that they can refer expectant women to depending on the unique circumstances of their pregnancy.

5.3.1.2 Improvements in administrative efficiency on antenatal health services

Honoring appointments is perhaps the most important activity during the phase when an expectant woman is under monitoring. Health professionals complained of women who sometimes skipped their appointments, placing their health and that of their baby at risk. Mobile health technologies can minimize the frequency of this anomaly by allowing the sending of appointment reminder through the short messaging services (SMS) to expectant women. The service could be extended to include information on the dangers of failing to adhere to set appointment dates.

5.3.1.3 Remote consultation/Telemedicine

Unscheduled appointments do provide challenges for the two health centers under review in this study. The hospitals are operating with a few doctors than they potentially need due to overstretched budgets. To overcome this challenge, mobile phones could allow the provision of remote consultation where expectant women at home are able to converse with their doctors. The latter can then determine whether the ailment or discomfort they are having is an issue that needs to be looked into on-site at a health facility or it's something that can be treated with over the counter medicine.

5.3.1.4 Emergency response

Mobile phones can be useful instruments in facilitating efficient response to expectant women in distress. A successful delivery is determined by the time taken to get a pregnant woman to the nearest health center under minimal time. Hospitals can use the USSD mobile dialing code service to help women, especially those in their final month of pregnancy, to notify emergency services on their exact location for quick extraction.

5.3.1.5 Real-time health-care updates

The current trend at Harare and Parirenyatwa hospitals is that expectant women are given updates on tests conducted only when they avail themselves for their next appointment. Mobile phones have the potential to notify patients to come and collect their results as soon as they are received from the lab or that they need to be under extra care based on the outcome of these lab tests.

5.3.2 Considerations for adopting mHealth technologies

The adoption of mHealth technologies in Zimbabwe's antenatal health sector has an unrealized potential that can be unlocked by taking advantage of the conditions obtaining in the sector's operating environment. These conditions include:

- A high proliferation of smartphones that are enabled to access mobile internet and social media applications.
- Willingness by patients and health professionals to adopt and make use of mHealth technologies to expedite communication and the flow of information.
- Relatively high levels of education among the average patient, making it easier for health professionals to conduct information literacy sessions on the use of mHealth technologies.
- A deliberate in-ward focus on ICT adoption which can prove to be significant platform when health-care centers eventually start working towards a technology-driven patient experience in future.
- International best practice in the use of mHealth technologies in countries such as Kenya which Zimbabwe can use as an example to roll out this service to its citizens.

- The presence of a National Health Information Strategy that can provide for the systematic co-ordination of efforts between policy makers, health-care professionals and citizens in the adoption and use of mHealth technologies.

5.4 Scope and limitations of the study

- The focus on just two hospitals, a select number of health professionals and a select number of women and/or expectant women cannot be taken as a conclusive reflection of Zimbabwe's entire health sector.
- A trial run (in a controlled setting) to assess the ability of respondents to use their mobile phones to access information on the internet, would have provided more insight on the real challenges affecting the wider adoption of mHealth technologies.
- The focus of the study on the potential of mHealth to the antenatal sector, was very restrictive as it denied the researcher the opportunity to consider the value of this technology to the health sector in its entirety.
- Some of the selected health-care professionals and expectant women from the two hospitals wanted to be compensated in the form of money for the time spent responding to questions.

5.5 Recommendations for further research

Mobile Health Technology is a growing field of inquiry in Zimbabwe and there are ample opportunities to grow the existing body of knowledge. Of particular interest, is the need to expend more time in reviewing the mobile health technology applications that are on the market and their suitability to developing countries such as Zimbabwe. Other potential research areas may include:

- While this study focused on the antenatal health sector, there is scope to extend the inquiry to mHealth use in the general health system.
- There is need to quantify the amount of resources that are being availed by the central government for the adoption of mHealth technologies and ascertain the impact that this investment is having on health-care delivery.
- Zimbabwe has a national health strategy in place which identifies mHealth as a critical instrument to enhance delivery. There is however a need to verify the extent to which the policymakers have gone in fulfilling its objectives including the challenges they are facing in doing so.

- Comparative studies on mobile technology use in developing studies can generate useful international best practice that can provide lessons for virgin markets such as Zimbabwe.

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APPENDICES

Due to the qualitative nature of this study, interviews were used as a data gathering technique. This chapter reflects on how data for this research was collected from the participants. It presents the permission letter that was granted to the researcher for data collection, the research form and consent form used to assure participants on the safety of confidentiality of the information they provide. It further presents a sample of the interview questions and answers (transcripts) and the request letter.