MOTHERS' PERCEIVED HEALTH WORKER INFORMATION AND COMMUNICATION TECHNOLOGY USE AND DISSEMINATED INFORMATION ON MATERNAL HEALTH PRACTICES IN NIGERIA

BY

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ABSTRACT

High maternal and child mortality rates have been linked to unhealthy practices by mothers in Nigeria. These practices could be traced to obsolete and inadequate information available to mothers. There are several e-health interventions by organisations to enhance Maternal Health Practices (MHP) with little consideration for mothers' perception of health worker Information and Communication Technology (ICT) use and relevance of disseminated information to MHP. This study, therefore, examined mothers' perceived health worker ICT use and the relevance of disseminated information to MHP in Nigeria.

Venkatesh's Unified Theory of Acceptance and Use of Technology provided the framework, while descriptive survey design was adopted. Nine public health facilities in Ondo (4), Imo (1), Kaduna (2) and Gombe (2) States with on-going e-health projects were purposively selected. Total enumeration technique was employed to select 931 mothers who were attending antenatal and postnatal clinics. Instruments used were Mothers' perceived health worker ICT use (α=0.79), Mothers' perception of disseminated information relevance (α=0.86) and MHP (α=0.81) scales. Quantitative data were complemented with four sessions of focus-group discussion with mothers in Ondo (10 participants), Imo (8 participants), Kaduna (6 participants) and Gombe (6 participants) States and key informant interviews with nine health workers in-charge of the e-health projects. Data were collection from February to September 2015. Descriptive statistics, Pearson's Product moment correlation and Multiple regression were used to analyse quantitative data at 0.05 level of significance, while qualitative data were content analysed.

Majority of the mothers were married (95.9%) and their mean age was 30 ±8 years. Maternal health information (MHI) was disseminated through mobile phones (76.0%), radio (66.9%), television (55.1%), public address system/projector (27.3%) and the Internet (2.4%). The MHI themes were on: appointment reminders (45.0%), emotional changes (39.5%), family

planning (34.0%), nutrition (32.8%), medication in pregnancy (30.6%) and breastfeeding (26.0%). About 96.0% of the mothers agreed that disseminated information were relevant. Mothers' perceived health workers' ICT use (r = 0.26) and disseminated information relevance (r = 0.31) had significant relationship with MHP of mothers. There was a significant joint contribution of mothers' perceived health workers' ICT use and disseminated information relevance on MHP (F $_{(2;\ 928)}$ = 60.87, R = 0.34, Adj. R^2 =0.11), accounting for 11.4% of its variance. Mothers' perceived disseminated information relevance (β = 0.32) and health workers' ICT use (β = 0.13) contributed to MHP. Unstable power supply and internet data cost are factors inhibiting effective use of ICT. Mothers stated that the disseminated information improved their MHP.

Health workers' effective use of information and communication technology and mothers' positive perception of disseminated information improved maternal health practices in public health facilities in Nigeria. Therefore, future e-health project should take cognizance of mothers' perception of health worker information and communication technology use and relevance of disseminated information to improve maternal health practices. Health policies should target Internet data subsidy for pregnant and nursing mothers to increase their access to e-health information.

Keywords: Perceived Health workers' ICT use, Mothers' perception of disseminated information, Maternal health practices, e-health in Nigeria

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DEDICATION

To the Almighty God, who has always been behind the scene to help my drooping hands.

CERTIFICATION

I certify that this work was carried out by **OLUWASEUN IRETI OBASOLA,** Matric number 141866, at the Department of Library, Archival and Information Studies, Faculty of Education, University of Ibadan, Nigeria.

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CHAPTER ONE

INTRODUCTION

1.1   Background to the study

Maternal health defined as the well-being of women during pregnancy, childbirth and the postpartum period *is* a very important issue that relates to a critical period in a woman's life. The reproductive period is the most productive for a woman, during which she strives to fulfill her potentials and contribute economically as a citizen of a nation (Adamu, 2011). At the micro level, maternal health has enormous impact on the survival of children under the age of five, and on the social and economic welfare of families. At the macro level, high maternal and child mortality has been linked to low productivity level in many developing regions. This has resulted in an economic loss of about $15 billion globally (Department For International Development -DFID, 2012).

Unfortunately, high maternal and child mortality has ravaged the developing regions, especially Africa. Women and children in these regions are susceptible to infection and death. An estimate from the United Nations' (UN) Statistics Division (2010) indicates that over 500,000 women and girls die annually from complications of pregnancy and childbirth. This implies that one girl or woman dies every minute during childbirth across the globe and, every year, over 5.9 million children under the age of five die due to preventable complications during pregnancy or after childbirth (Asian Pacific Dialogue for Women and Children, 2006; WHO Factsheet, 2016).

About 50% of all maternal deaths across the globe occur in Africa, which has only 15% of the world's population (Africa Progress Panel Policy, 2010). Nigeria constitutes just 1% of the world population, yet it accounts for 14% of the world's maternal mortality rates (Ogunjimi, Ibe, and Ikorok, 2012; World Health Organization, 2012). In 2010, an estimate of about 40,000 Nigerian women died in pregnancy, while about 1million to 1.6 million suffered from serious complications of pregnancy and childbirth, including severe bleeding after childbirth, infections, hypertensive disorders, and unsafe abortion. With a maternal mortality rate of 630 per 100000 live births, Nigeria is amongst countries with unacceptably high maternal mortality rate. It ranks highest in Africa in terms of the number of neonatal deaths and contributes significantly to the world's annual maternal deaths. Approximately, one in every nine maternal deaths worldwide is a Nigerian woman (Federal Ministry of Health Nigeria, 2011; USAID, 2012; WHO and UNICEF 2012; WHO, UNICEF, UNFPA, and The World Bank, 2012). Cooke and Tahir (2013) in a report by Centre for Strategic and International Development USA, on Maternal Health in Nigeria, argue that: "In achieving the Millennium Development Goal of reducing global mortality rate by 75% before 2015, progress in Nigeria could prove pivotal".

A study published in Lancet in May 2016 also indicates that Nigeria's maternal and child mortality remains high (Victora, Requejo, Berman, Bhutta, Chopra, de Francisco, Daelmans, Hazel, Lawn, Maliqi, Newby, Bryce, 2016). A Nigerian woman's risk of dying from pregnancy or childbirth is 1 in 29, compared to the sub-Saharan average of 1 in 39, and the global average of 1 in 180. She is also often influenced by her partner's decisions with little or no say on issues affecting her well-being and that of her child (USAID, 2012; DFID, 2012; Cooke and Tahir, 2013). Nigerian women go through much trauma and emotional stress, especially during their reproductive and productive years.

The World Health Organisation (WHO) stated in the WHO Factsheet (2012) that most of the maternal deaths in the developing world, especially Nigeria, could be averted if women are

adequately informed about right practices to adopt before, during and after pregnancy. About 75% of these deaths could have been prevented if the mothers were informed about the right maternal and child health (MCH) practices that would aid the prevention of pregnancy and birth complication.

According to WHO (2007), Maternal and Child Health (MCH) practices, are health-related actions that mothers are expected to adopt to promote their health and that of their babies. Such efforts include regular antenatal and postnatal visits, family planning methods, nutrition in pregnancy, breast feeding and child immunisation. They also include routine delivery and referrals practices by skilled health workers. Other standard MCH practices recommended by the World Health Organisation include the uptake of two doses of tetanus injection by mothers one month apart before delivery, or an uptake of five doses before delivery, in situations where their medical records are not available. In addition, they are supposed to have access to accurate information on the prevention and recognition of Sexually Transmitted Infections (STIs) and Reproductive Tract Infections (RTIs). In areas with high prevalence of malaria, it is important for all pregnant women to sleep under an Insecticide Treated Net (ITN). To avoid malnutrition and to prevent anemia, they should routinely receive iron and folate supplements and appropriate dietary advice, to prevent anemia (WHO, 2012). These MCH practices are meant to prevent pregnancy complications, unwanted conception, or (and) ensure the safety of mother and child during pregnancy, childbirth and postpartum period.

Most of the unhealthy MCH practices mothers adopt during pregnancy have been linked to the high maternal and child deaths experienced in the developing countries (WHO 2012). For instance, in Maputo and Gaza province in Mozambique, high maternal mortality was reported amongst women in the rural communities because of misinformation. Most women and their partners in these communities thought that lower abdominal pain is the only symptom requiring

care and discouraged women from seeking antenatal care on time if they did not experience any abdominal pain. Other symptoms such as headaches, flu-like symptoms, body pain and backache were not taken as serious health issues(Munguambe. , Boene , Vidler. , Bique., Sawchuck. , Firoz , Makanga , Qureshi, Macete, Menéndez., von Dadelszen. and Sevene , 2016). Similarly, the high maternal and child morbidity in Ghana has been linked to inadequate maternal education, low completion rates of immunization programmes and unhygienic practices (Quansah , Ohene , Norman , Mireku. and Karikari , 2016).

The public health challenge has attracted the attention of international organisations like United Nations (UN), World Bank, World Health Organization (WHO) and Non-governmental Organizations (NGOs) such as, the United States International Development Agency (USAID) and other stakeholder in the health sector. It is noteworthy that significant efforts have been made since the 1990s to alleviate this public health burden. This was amplified after the Millennium Development Goal (MDG) summit in 2000 where the 2015 target was set (United Nations, 2000).

In Nigeria, most of the unhealthy practices of women and their family members during pregnancy have been identified as some of the direct causes of maternal deaths (Doctor, Bairagi , Findley, Helleringer and Dahiru , 2011). Unhealthy practices are diverse and examples include poor nutrition and feeding habits, and lack of personal hygiene. While the standard MCH practices are based on data and evidence from research, traditional MCH practices are mostly based on myths, religious codes, superstitions and cultural beliefs. Such beliefs require upholding food taboos, which affect mother's nutrition and taking harmful herbs instead of vitamins during pregnancy (Ogunjimi et al, 2012). Many casualties and deaths have resulted from misinformation or sometimes inadequate information on healthy practices during pregnancy. Most of the time women and their family members end up adopting the traditional practices for MCH care which

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often result in complications and is responsible for a significant proportions of maternal and child deaths in the country (Federal Ministry of Health 2011).

Stressing the problem of high mortality as a result of unhealthy practices due to inadequate MCH information dissemination, a survey by the Federal Ministry of Health, Nigeria (2011) and John Hopkins Programme for International Education in Gynecology and Obstetrics (Jhpiego) revealed the need to scale up information dissemination, since over 60% of Nigerian mothers who use traditional birth attendants are still not aware of available maternal health services. They are not adequately informed about the safe MCH practices to adopt during or after pregnancy.

To ensure the adoption of safe maternal health practices by mothers, it is pertinent to continuously disseminate maternal and child health (MCH) information to mothers along the continuum of care. This implies that relevant MCH information should be disseminated by health workers to mothers at all times. Information dissemination requires systematic planning, collection, organisation and storage of information (Dhawan,2006) to ensure the development of information content that takes into account intervening factors, such as age, sex, language, level of income, literacy level and ethnicity, shared by the target group (Grimshaw, Shirran, Thomas, Mowatt, Fraser, Bero, Grilli, Harvey, Oxman, and O'Brien, 2001; Parmar, 2009). Information dissemination is usually carried out using various channels, social contexts and settings. Common methods used in disseminating information to the public include the use of posters, pamphlets and ICT such as radio, television, mobile phone and the Internet (Agency for Health Care Research Quality 2012). Sustained information dissemination can be achieved by ensuring that health workers disseminate information on safe MCH practices to mothers before conception, during pregnancy, at birth and postpartum using ICT. Information and Communication Technology (ICT), an array of technologies that are used to process information and aid communication, can be used as a tool for disseminating safe MCH practices to improve maternal and child health. This

will accelerate the desired reduction in maternal and child mortality. (Omona and Ikoja-Odongo, 2006; Asenso-Okyere and Mekonnen, 2012).

Several studies have revealed the use of ICT for maternal and child health care in other countries. From the literature , an early application of ICT by health workers as reported by Maheu, Whitten and Allen (2001), was the use of radio communication systems for providing health information and services to Antarctica in the 1900s. By 1910, the first trans-telephonic stethoscope was tested in England. This led to the evolution of the term telemedicine. According to Williemaim and Mark (1971), in Maheu et al. (2001), telemedicine was coined about thirty years ago and was defined by Maheu, Whitten and Allen (2001) as: "The provision of health care services, clinical information and education over a distance using telecommunication technology."

Early applications of telemedicine mentioned by these scholars include group therapy, nursing interactions, and tele-visits to community health workers, telemetry medical image transmission, home care, education and training. Institutions involved in the initial adoption of telemedicine included Nebraska Psychiatric Institute, Massachusetts General Hospital and National Aeronautics and Space Administration, all in the United States of America. In 1985, the SateLife/HealthNet project provided health communication information and services in developing nations. This comprises nine African nations, the Philippines and three countries in the Americas. The project provided electronic mail (email) communications and Compact Disk Read Only Memory (CD-ROM) via the health Satellite at minimal cost. According to Maheu et al. (2001), these applications of telemedicine helped overcome social, political, distance, cultural and economic barriers. The application of ICT in the instances mentioned also set the stage for similar application of other ICT for the delivery of health information and services (Garshnek and Hassel 1997 cited in Maheu et al., 2001).

The applications of ICT for delivering health information and services received a further boost in the 1990s, when mobile networks expanded in developing countries. As a result, these countries gained access to wireless handsets, which created a unique opportunity for information dissemination and management. This boost culminated in a key development in 2003 when a biomedical engineer, Robert Istenpanian, coined the term m-health. The term mobile health(m-health), a sub-segment of electronic health (e-health), is the application of ICT, such as computers, mobile phones, communications satellite, patient monitors and portable devices, for the delivery of health information and services (Istepanian, Laxminarayan and Pattichis, 2005; Vital Wave Consulting, 2009; Cipresso, Serino, Villani, Repetto, Selitti, Albani, Mauro, Gaggioli and Riva, 2012).

A notable application of ICT for MCH is the "Text4baby" programme which was launched in 2010 in the United States. The project provides text-messaging service that sends free text messages to women who are pregnant or had children less than a year old, supplying them with information and reminders to improve their health and the health of their babies. Women sign up for the service by sending a text message with their child's expected birth date and they receive three messages a week offering evidence-based information relevant to the stage of pregnancy they are in. The project is an initiative of the National Healthy Mothers and Healthy Babies Coalition. It is supported by a public–private partnership that includes Johnson and Johnson (founding sponsor), the White House Office of Science and Technology Policy, Health and Human Services, Department of Defense, and other private and non-profit partners. The project is also being implemented in Russia (Evans, Abram, Poropatch, Nielsen and Wallace, 2012; Parker, Dmitrieva, Frolov and Gazmararian, 2012).

The Lady Health Worker's project initiated in Pakistan in 1994 is another important intervention for MCH. It equips Lady Health Workers with mobile devices to enable

communication with supervisors and allow more efficient referral of serious cases, to improve maternal health care in rural areas of Pakistan (Hafeez, Mohamud , Shiekh , Shah and Jooma, 2011). Likewise, the mCARE project in Bangladesh utilises mobile phone and database technologies to improve monitoring of pregnant women and new-born babies during and after pregnancy. It serves as a link between community health workers and their clients in order to improve health surveillance, facilitate referrals and improve overall care. The project is being supported by Johns Hopkins Bloomberg School of Public Health, mPower-health, JiVitA Maternal Child Health and Nutrition Research Project, Bangladesh's Ministry of Health and Family Welfare and UBS Optimus Foundation (UBS Optimus Foundation, 2011). Similarly, the Wired Mothers Project in Zanzibar Tanzania adopted the use of mobile phones for maternal health care. The project linked pregnant women referred to as "Wired Mothers" to primary health care units through the use of phones; this was with the aim of increasing access to skilled attendance at delivery. The project enjoys support from the University of Copenhagen, Ministry of Health and Social Welfare, Zanzibar, Tanzania; Health Sector Programme Support Zanzibar and Danida Health Sector Programme Support (Lund, Hemed,, Nielsen Said, Said, Makungu,and Rasch, 2012).

Georgetown University's Institute Reproductive Health also uses the mobile phone and computer for the promotion of reproductive health in two Indian cities; Lucknow and New Delhi. The initiative adopted the use of Frontline SMS open source software that turns a laptop and a mobile phone into central communication hub. The software allows users to send, receive and manage text with group of people through mobile phones without using the Internet. Institute for Reproductive Health developed an SMS (short message service) called Cycle Tel designed to empower women by providing information on reproductive health which facilitates the use of natural birth control methods. This allows women to identify fertile days during the menstrual

cycle so as to avoid unprotected sex and prevent unwanted pregnancy(FrontlineSMS and Georgetown University's Institute for Reproductive Health, 2011).

As reported by Musoke (2002) and Tamrat and Kachnowski (2011), the earliest application of ICT for maternal health in Africa was reported by Musoke in an intervention tagged the Rescuer Project launched in 1996 by the World Bank. The project used radio communication systems for obstetric emergencies. Several studies have revealed the use of ICT in some other African countries. For example, in Egypt, the use of mobile phones has helped to reduce the response time for obstetric emergencies (Mechael, 2005). Likewise, in Iganga District in Eastern Uganda, simple ICT (radio communication system) was used by traditional birth attendants (TBAs) to collaborate with the public health facilities to deliver health care to pregnant women. This resulted in increased and prompt patient referrals as well as the delivery of health care services to a larger number of pregnant women (Musoke, 2002).

According to a study conducted in Africa in 2007, the use of ICT has had significant impacts on the health sector. The study reported the use of ICT tools for linking community health workers in the rural areas to central health information systems in the cities. The tools were also used for the collection of patient data which was used to support decision making by the health workers. ICT tools were also employed for health promotion. It involved the use of mobile phones to disseminate health tips as voice messages and SMS (text messages) to patients to improve their knowledge about their health. Other application of ICT for health care delivery identified in the study include, its use for supporting treatment compliance, emergency medical response, disease prevention and surveillance (Earth Institute, Columbia,2013).

In the case of Nigeria, the use of ICT for MCH is still evolving. According to Idowu, Ogunbodede and Idowu (2003), ICT tools used by Nigerian health workers are personal computers, mobile phones, the Internet, radio, television, email and fixed landline telephones.

While tools such as radio and television have been used for generations to disseminate health information, the adoption of the more recent ones, like mobile phones and the Internet has been growing at a very fast pace (Vital Wave Consulting,2009; USAID 2011). In 2009, Olatokun and Adeboyejo identified ICT tools used by reproductive health workers in Nigeria, to include multimedia projectors/laptops, video-conferencing, Internet connectivity, email services and the World Wide Web.

Of all the ICT used, the radio has been identified as the most enduring and established, and has continued to play a central role in the development of health communication in many countries. It is an essential tool used for information dissemination, communication and behaviour communication change in low income countries especially in rural areas (McConnell, Heads, Drury, Kumekawa, Louw, Fereday, Davies, Nyamai-Kisia and Nyambura, 2005). Radio has been used successfully for a number of health programmes promoting child immunisation, family planning, treating childhood illness etc. It can reach large audiences at minimal cost regardless of geographical boundaries and literacy levels.

As reported by Fajembola (2012), a laudable application of mobile phone by health workers for MCH information dissemination is the Safe Motherhood (*Abiye*) programme in Ondo State. In Gombe State, the Society for Family Health (SFH) maternal health programme also adopted the use of call centres for the promotion of safe MCH practices in the State to improve MCH (Onoriode , Otunomeruke, Ofuogbu, Muhammed and Anyanti, 2012). Another collaborative effort between the National Primary Health Care Development Agency (NPHCDA) in Nigeria and Duke University, Durham, North Carolina, USA has also employed the use of ICT (www.mMCHIT.org). The project involves the use of mobile phones by health workers to capture individual patient data on Java-enabled mobile phones (mMCHIT) and to disseminate the data to health workers. Other applications of ICT by Nigerian health workers are the use of ICT for

interactive programming on broadcast media, electronic patient records, telemedicine and the development of web interface for accessing and disseminating information (Shilderman 2002; Chetleym et al, 2006).

Despite the soaring popularity of e-health and the potential of ICT for health information dissemination, studies providing documentation on its application, best practices, lessons learnt and its influence on MCH practices, maternal and child mortality/morbidity are few in Nigeria (Oyeyemi, 2012 ; Ohuruogu,Flores and Foh, 2016). Noordam et al. (2011), Tamrat and Kachnowski (2011) and Pathfinder (2015) in their review of m-health programmes for maternal and newborn around the world note the need for robust studies on the impact of ICT to improve the quality of e-health project. These studies underline the need for a study focusing on the efficacy and effectiveness of ICT for health projects on MCH. This is to ensure that gaps in the existing information dissemination strategy, channels, products, and systems are systematically addressed, to provide an avenue for transfer of practices, knowledge and experiences from other studies, and explores the possibility of adaptation of ICT in settings ravaged by high maternal and child mortality.

The use of ICT for MCH care as highlighted in previous studies has made the dissemination of MCH information to target audiences easier and faster. As a result, effective information dissemination with the aid of ICT has been described as vital to the adoption of safe maternal and child health (MCH) practice by mothers worldwide (Parmar, 2009; Skaria, 2011; Oyeyemi, 2012;). However, even when ICT is used for MCH information dissemination, it is important that MCH information and ICT are well received and accepted by the target group, in this context the mothers. Thus, it is important to determine whether mothers' perception of ICT use and relevance of information emanating from ICT is positive or negative. According to information transmission theory, information takes the form of the medium of transmission. The

implication of this is that information being disseminated cannot be separated from its medium of transmission (Dobrushin, Garmash, Lebedev, Pinsker, Sagalovich, 1970). Hence the study will focus on mothers' perception of ICT as well as the relevance of disseminated information. Parkkola (2006) highlighted the importance of exploring mothers' perception in a study in India. Results from the investigation reveal a positive disposition by mothers toward ICT, once they are convinced of its usefulness. This positive disposition was also confirmed by Lemish and Cohen (2005) whose study in Isreal indicates that women are positively disposed to using mobile phones in the same manner as men.

However, the positive disposition of mothers observed in the study varies from the findings of previous studies. For example, Tiainen (2002) and Oksman (2003) studies revealed a negative disposition to ICT by Finnish women. Likewise, Castle, Thompson, Karlyn, (2011) in a study in Kaduna State, Nigeria revealed a negative disposition by mothers to use of mobile phones for receiving MCH information. As a result, most of the mothers lacked the willingness to participate in ICT-based projects for MCH in the rural communities of the state. Consequently, the willingness to use ICT as source of MCH information may be dependent on users' (mothers') perception of ICT and relevance of information emanating from this source. Venkatesh et. al (2003) illustrated how the perceived usefulness of an information system could have profound influence on health information seeking behaviour (health practices), which is further influenced by the ease of use and convenience of the type of ICT tool.

This study examined the use of ICT by Nigerian health workers for MCH information dissemination from the mothers' perspective. The health workers considered are midwives, nurses, community health workers, who are directly involved in the care of pregnant women, nursing mothers and their children at all levels of health care. Mothers in the context of this study refer to a heterogeneous mix of pregnant women and nursing mothers with different educational, social, and cultural background who are currently involved in on-going ICT-based projects in

Nigeria. It ascertains the relationship between health workers' ICT use as expressed by the mothers, their perceived relevance of ICT-disseminated MCH information and their MCH practices. It intends to identify the shortcomings in existing information dissemination structures and come up with findings that would be useful for scaling up the use of ICT for MCH in Nigeria. Majority of studies on ICT-based programmes for MCH in Nigeria have focused on the impact of use of ICT for MCH care on health outcomes such as number of birth deliveries and referrals (Osuagwu, Ogini, Udoka and Agbasonu, 2010; Fajembola, 2011, Oyeyemi, 2012 and Pathfinder ,2015). Most of the studies paid little attention to mothers' perception of the use of ICT by health workers for information dissemination on safe MCH practices and their perceived relevance of ICT- disseminated MCH information. The study is expected to fill the gap.

1.2   Statement of the problem

The World Health Organisation stated in its factsheet that most of the maternal and child deaths in the developing world, especially Nigeria, could be averted if women were adequately informed about the right practices to adopt before, during and after pregnancy. Hence, exploring available mechanisms and platforms for enlightening mothers about practices that could prevent pregnancy and birth complications is pivotal to the reduction of maternal and child mortality. This has resulted in the adoption of ICT for MCH information dissemination as a strategy for preventing pregnancy and birth complications.

The adoption of ICT for enhancing healthcare service has spread across sub-Saharan Africa. Nigeria is gradually preparing available health facilities and health workers for technology driven MCH services. In spite of the preference and adoption of ICT for promoting safe MCH practices, Nigeria's maternal and child mortality rate remains high. This is in contrast with the significant reduction in mortality recorded in developed countries that have adopted the use of ICT. The situation has been attributed to negative perceptions recorded by mothers as indicated in

earlier studies. This state of affair, if not addressed, may inhibit the scale -up of the use of ICT for disseminating MCH information and consequently, the wide adoption of safe MCH practices promoted through ICT.

To ensure effective MCH information using ICT, it is important to examine its influence on the adoption of safe MCH information being disseminated from mothers' perception. The varying dispositions of mothers to MCH information emanating from ICT need to be addressed, since mothers' disposition has been linked to the appropriateness and acceptability of the ICT and content of MCH information received from ICT. This could reveal more facts that could be central to the design of ICT-based intervention projects.

The need to focus on mothers' perception is further amplified by the skewed findings from literature which reveal several studies on the influence of the use of ICT by health workers on health outcomes such as number of referrals and skilled-birth deliveries. However, studies on the health workers' ICT use and perceived relevance of ICT-disseminated MCH information from mothers' perspective, as well as the influence on MCH practices are rare. Therefore, investigating the use of ICT by health workers for disseminating MCH information, the relevance of ICT-disseminated information from mothers' perception and the influence on MCH practices in Nigeria becomes vital. This study investigates the influence of mothers' perception of health workers' ICT use and perceived relevance of ICT-disseminated MCH information on their MCH practices. This has the potential to initiate a paradigm shift in the design of maternal and child health information products, a necessary prerequisite for scaling up current pilot ICT-based intervention programmes for MCH.

1.3   Objectives of the study

The main objective of the study is to investigate the use of ICT by health workers for information dissemination on safe maternal and child health (MCH) practices from the perspective of Nigerian mothers. Specific objectives of the study are to:

i.   identify the types of ICT health workers use to disseminate information on MCH;

ii.   identify the types of MCH information disseminated to mothers by health workers using ICT;

iii. find out mothers' perceived usefulness of ICT and the relevance of MCH information disseminated to them by health workers using ICT;

iv.   determine the effect of mothers' perception of health workers' ICT use for MCH information dissemination on their MCH practices;

v.   identify the MCH practices mothers adopt after receiving MCH information from health workers through ICT;

vi.   identify the challenges encountered by health workers and mothers when using ICT to disseminate or receive MCH information;

vii. identify the challenges encountered by mothers when adopting MCH information from ICT;

viii. determine the relationship between mothers' perception of the relevance of ICT-disseminated MCH information and their MCH practices;

ix.   ascertain the effect of mothers' perception of health workers' ICT use and their perceived relevance of disseminated information on their MCH practices.

1.4   Research questions

The research provides answers to the following questions:

1. What types of ICT do health workers use for disseminating information on MCH in Nigeria?

2. What types of MCH information are disseminated to mothers by Nigerian health workers using ICT?

3. What are mothers' perceived usefulness of ICT and MCH information disseminated using ICT?

4. What is the effect of mothers' perception of health workers' ICT use for MCH information dissemination on MCH practices of mothers in Nigeria?

5. What are the MCH practices mothers adopt after receiving MCH information from health workers through ICT?

6. What are the challenges encountered by health workers and mothers when using ICT to disseminate or receive MCH information?

7. What are the challenges encountered when adopting MCH information disseminated by health workers using ICT?

1.5   Hypotheses

The hypotheses of the study stated in null form have been tested in the study at 0.05 level of significance.

i.   Mothers' perceived health worker ICT use use for MCH information dissemination will not significantly affect maternal and child health (MCH) practices of Nigerian mothers.

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ii. There is no significant relationship between mothers' perception of MCH information disseminated through ICT and MCH practices of mothers in Nigeria.

iii. Mothers' perception of health workers' ICT use and MCH information disseminated through ICT will not significantly affect their MCH practices.

iv. There is no significant relative effect of mothers' perception of health workers' ICT use and MCH information disseminated through ICT on MCH practices.

1.6   Scope of the study

The study focused on the use of ICT by health workers for information dissemination on safe MCH practices to mothers. It also examined mothers' perceived relevance of ICT-disseminated MCH information and the influence on their MCH practices. The study was conducted in four states with on-going ICT-based projects for MCH, supported by government.
The states are Ondo, Imo, Kaduna and Gombe States. The states are located in four out of the six geo-political zones of Nigeria. The states were identified by contacting the management of federal health tertiary institutions in each zone as well as the state ministry of health in each state. The research involved mothers who were currently involved in ICT-based project for MCH in the four geo-political zones. It also included health workers (nurses and community health workers) who were directly involved in the use of ICT for MCH care. Health workers that were not directly involved in the ICT-based projects were excluded from the study.

The work examined the use of ICT (radio, phone, computer/Internet, television/digital video, Internet, and laptop/projector) by health workers as reported by mothers, type of MCH information disseminated, mother's perception of ICT-disseminated information as well as the relevance of the information to their maternal health practices. The maternal and child health

practices considered in the study included health related actions (antenatal/postnatal visits, nutrition in pregnancy, breastfeeding, family planning and child immunisation) adopted by health workers and mothers in promoting their health and that of their baby.

1.7   Significance of the study

The study revealed some of the effects of the use of ICT for information dissemination on safe MCH practices in Nigeria. Specific applications of ICT for the promotion of maternal and child health practices by health workers were identified alongside the factors limiting the application. This has revealed the extent to which the use of ICT has affected their practice and how its use can be enhanced to further improve MCH care.

It is anticipated that the outcome of this analysis would be valuable to developers of ICT-based (e-health) programmes for maternal health care in Nigeria. Policy makers will also find the knowledge provided by the study useful in the formulation of policies that can guide the use of ICT for MCH care in the country. It will provide useful information for the development and adoption of ICT solutions for MCH in a way that can effectively support health workers in the care of mother and children. It will also promote the dissemination of information on MCH in ways that encourage use; thus, encouraging mothers to adopt safe MCH practices. In addition, other states in the country that are yet to start the ICT-based programme for MCH can take a cue from findings from this study to enable them set up effective ICT-based programmes for MCH. Another very important output would be data, statistics, and information on the use of ICT by health workers, and the understanding of mothers' perception of different information dissemination methods in relation to MCH practices. Data emanating from this study would constitute a vital asset for researchers and students in public health and information science.

1.8 Operational definition of terms

The following terms have been defined in the context in which they have been used in the study:

Health workers: These are nurses (medium-skilled), midwives and volunteers (low-skilled) who use of ICT for maternal and child health (MCH) care.

Information and Communication Technology (ICT): This refers to communication device or application, including: radio, television, mobile phones, projectors computer and Internet used by health workers for maternal and child health care.

Information and Communication Technology (ICT) Use: This refers to the adoption of communication devices such as radio, television/Digital Video (DVD), Internet and mobile phones for information dissemination on safe MCH practices to mothers.

Mothers' perceived health worker ICT use use: This refers to the adoption of ICT by health workers for information dissemination on safe MCH practices as reported by the mothers.

Information dissemination: This refers to the provision of health tips or messages useful in the prevention, diagnosis, and management of complications both in pregnancy and after childbirth to ensure the well-being of mother and child.

Information dissemination channels: This refers to devices used in communicating maternal health information to mothers. Examples include radio, television, projector, Internet and mobile phones.

Maternal health practices: This refers to actions such as regular antenatal visits, postnatal visits, immunisation, breastfeeding, nutrition in pregnancy, and family planning methods adopted by a mother to promote her well-being and that of her child. Hence, the terms "Maternal Health and "Maternal and Child health" were used interchangeably in this thesis.

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Mothers' perception of ICT-disseminated information: This refers to pregnant women's disposition on the usefulness of ICT and understanding of the relevance of disseminated MCH information, as well as the influence on their MCH practices.

CHAPTER TWO

LITERATURE REVIEW

2.1   Introduction

The literature review presents a synopsis of applications of ICT by health workers for maternal and child health (MCH) in Nigeria. It provides an overview of information dissemination methods for MCH in Nigeria and barriers to e-health project implementation and acceptance. The section focused on projects involving the use of ICT by health workers for MCH in Nigeria and mothers' perception of ICT and information emanating from the channel.

Related literature has been reviewed under the following sub-headings:

2.2   ICT use by health workers for maternal and child health care in Nigeria

2.3   Information dissemination methods for maternal and child health in Nigeria

2.4   Mothers' perception of disseminated information

2.5   Maternal and child health practices in Nigeria

2.6   Health workers use of ICT for MCH information dissemination and MCH practices

2.7   Mothers' perception of ICT-disseminated information and MCH Practices

2.8   Challenges of e-health project reception and implementation

2.9   Theoretical framework

2.10   Conceptual model of the study

2.11   Appraisal of the literature reviewed

2.2 ICT use by health workers for maternal and child health care in Nigeria

The realisation that ICT has the potential of accelerating the progress made towards the 2015 MDG target of reducing child mortality and improving maternal and child health (MCH) outcomes resulted in the initiation of several intervention projects involving the use of ICT by health workers for MCH care in developing nations, especially Nigeria (Victoria and Nicogossian, 2011). A literature search using Google Scholar, PubMed and Global health revealed seven (e-health) projects in which health workers adopted the use of ICT for maternal and child health care in Nigeria. These include: Mailafiya Project – FCT, Abuja, Maternal and Neonatal Health Care (MNHC) Learning Project Gombe State, Safe Motherhood Project (Abiye) in Ondo State, Mobile Maternal Child Health Information Technology (mMCHIT), Mobile Community Based Surveillance (mCBS), OpenMRS(Open Source Electronic Medical Record System) to support Maternal and Reproductive Health in Kaduna State and m-health services for MCH at Federal Medical Centre Owerri.

The Mailafiya project implemented in Abuja, used Information and Communication Technology(ICT) to bring about improvements in Millennium Development Goals 4 (reduce child mortality) and 5 (improve maternal health) (United Nations, 2000). The project deployed mobile health care teams equipped with off-road trucks, basic health care tools, and drug kits with cost-effective Intel-powered netbooks. The netbooks contained electronic health record software which collected data such as, patient records and pictures captured using the Intel-powered PC's camera. The teams used ICT to disseminate information, carry out automated lab tests for on-site diagnosis and treatment (Intel White Paper, 2010). The ICT tools improved access to health information, drug dispensing, treatment follow-up, and referrals. The pilot phase proved effective by increasing patients seen by 270% and disease reporting by 900%. The improved data flow enabled the right health care interventions at the right time, and has revolutionised health care delivery to urban and rural areas, in over 400 communities and 113 Local Government Areas (Intel, 2013).

In Gombe State, the Maternal, Neonatal and Child Health (MNCH) learning project resulted from the collaboration amongst the following three organisations: Society for Family Health (SFH), Population Services International (PSI) and Transaid in the United Kingdom. The project, designed to reach rural populations, was successful as health workers were able to use mobile phone to assist families manage MCH issues and to set up referrals (Society for Family Health, 2012). One critical element of this project was the practical display of private-public partnership (PPP). The Call Centres/Hotlines were set up in Gombe State general hospitals. The hotlines were obtained from telephone service providers and the resultant data were used to track calls (SFH website). Findings from the study of Onoriode et. al (2012) revealed that within four months of the project initiation, 24989 calls were received; out of which 11709 enquiries were related to maternal and neonatal health. Over 50% of the callers were first-time mothers.

Furthermore, 400 women provided positive feedback on the quality of information and support from the centre. The information dissemination methods used in creating awareness for the project included radio, billboards, prints and inter-personal communication. This shows the relevance and effectiveness of traditional media. Some of the significant results of the project include improved access to accurate health information, access to health care and timely response to obstetric emergencies which hinged on creating awareness about the call centres (Onoriode, Otunomeruke, Ofuogbu, Mohammed and Anyanti, 2012).

The MNCH Learning project demonstrated mothers' desire to make enquiry about their health in general, especially maternal and neonatal health. The project which was a result of team work amongst health workers, NGOs and government, achieved the desired objectives. Awareness creation about the call centres was strategic, as it influenced people to make enquiries through the call centres (Voller and Becker, 2014). In addition, state ownership was strategic and could pivot the project towards sustainability Feedbacks from users could form the basis for future planning and service delivery. This call centre model if integrated into other maternal health interventions

and replicated on a nationwide-scale could initiate the necessary behavioural change and adoption of safe MCH practices (Society for Family Health, 2012).

Another impressive project is the Safe Motherhood Project (Abiye) initiated by the Ondo State Government. The term *Abiye* is a Yoruba word which means safe delivery. The health project was designed to tackle the burden of high maternal and child deaths in the state, which, according to WHO has the highest number of maternal and child deaths in South-West Nigeria (Kayode, 2014). Furthermore, a baseline study carried out by the state government revealed that only 16% of women who register at the health facilities in the state eventually give birth in the health facilities. This spurred the initiation of *Abiye,* a pilot project which targets primary health care facilities (Adeyanju, 2012).

The project was initiated in 2009 at Ifedore Local Government Area of the state in order to achieve significant (60%) increase in the utilisation of health facilities and reduction of about 50% in maternal and neonatal mortality rates. The project involved the use of community health extension workers (referred to as "health rangers") trained on basic obstetric care, intensive care, expanded life-saving skills and family planning to deliver services to mothers (Fajembola, 2011). The health rangers were equipped with mobile phones and also connected to 25 pregnant women each, whom they were expected to monitor. The project employed the use of tricycle ambulances for the mobilisation of health rangers as well as evacuation of patients in case of emergencies. According to the mothers, the state government was able to provide free phones to pregnant women, health rangers, nurses, health facilities, and ambulance through a public-private partnership with Globacom, a GSM company which provided Closed-Users'-Group (CUG) cell phones for the project. The cell phones were given out free, and calls made free of charge within the CUG. Thus, the pregnant mothers reported that they did not need to pay or be charged to make calls (at any time) to the health rangers or the health facilities. Equally, calls made by other

stakeholders in the CUG were also free. This facilitated referral which countered the third and first phases of delay to getting health care encountered by pregnant women. It also led to a 30% reduction in MMR two years after its inception, and was able to save 1220 babies with only one mortality reported in a year (Oyeyemi, 2012; Ohuruogu,Flores and Foh, 2016).

The broadest of all e-health intervention for MCH in Nigeria covered by this literature review is The mobile Maternal Child Health Information Technology (mMCHIT) project . This project was an alliance between the Nigerian National Primary Health Care Development Agency (NPHCDA) and Duke University, Durham, North Carolina, USA. mMCHIT is a comprehensive set of ICT solutions designed to complement the efforts of the MDG- supported Midwifery Service Scheme (MSS). It covers all geopolitical zones with 815 participating health facilities: 652 PHC facilities and 163 general hospitals (Abimbola et. al 2012; Okpani and Abimbola, 2016). The Nigeria Midwife Scheme was initiated in 2009 by the NPHCDA to accelerate progress towards meeting the MDG target. The mMCHIT is being implemented in six states selected from each geopolitical zone. The states are Sokoto, Bauchi, Niger, Anambra, Bayelsa and Ekiti. The MSS has a structure in which facilities selected were linked in an effective two-way referral system through a cluster model in which four PHC facilities with the capacity to provide basic essential obstetric care were clustered around a general hospital with the capacity to provide comprehensive emergency obstetric care (Adetoro and Aboda, 2011).

mMCHIT focuses on the implementation of Decision Support Systems (DSS) and a robust Electronic Health Record System. The mMCHIT mobile is a component of the mMCHIT project. It is made up of a Java application designed to capture individual patient data on a Java-enabled mobile phone. It is used in the delivery of MCH information to health workers. The mMCHIT mobile has the ability to send completed forms via SMS or GPRS (depending on GPRS availability and airtime credit) to a server which has the capability to extract reports and send to

the Demographic Health Information Systems (DHIS), which is the national health management information system in Nigeria (mMCHIT.org). Based on experts' recommendations, only the vital part of patient data is accommodated by the forms. This is to monitor women from early stages of pregnancy to childbirth and beyond, as well as monitor the babies from birth to age five (Abimbola, Okoli, Olalekan, Abdullahi and Pate, 2012; Okpani and Abimbola, 2016).

In order to achieve these goals, two versions of mMCHIT mobile were developed. The first version, mMCHIT mobile-ANC, is an application designed to be used by a midwife or community health extension worker during antenatal care visits only. The second version, mMCHIT mobile-0-5, is designed to be used by any health worker during child immunisation visits. It is designed to accommodate changing needs of the patient as the child grows (Brief from the states: mMCHIT.org).

The mMCHIT is still at the early stage and little information has been gathered regarding outcomes from the project. Some of the challenges faced by mMCHIT for MSS are low IT skill, lack of awareness, faulty hardware/software, maintenance problem and poor mobile network coverage. A major limitation identified by the mothers and reported on the project website in some of the states is the use of an inappropriate integration approach. For example, three of the primary health care facilities in some of the states used the community-based approach to health care; while the mMCHIT solutions are clinic-based. This made its use impossible owing to distance and poor network coverage (NPHCDA, 2012).

Other challenges such as IT skill, awareness, faulty hardware/software, maintenance and poor mobile network service must be solved to achieve the desired outcomes for MSS. Therefore, the MSS scheme has a lot to learn from Mailafiya, MNCH Learning and Abiye Projects in order to be effective.

In the northern part of the country two e-health projects were supported by the government. The first, the Mobile Community-Based Surveillance (mCBS) project was initiated in 2010 with support from e-health Nigeria, MacArthur Foundation, Population and Reproductive Health Initiative and Population Council. The mCBS is being implemented in Kaduna State and its main goal is to build the ability of traditional birth attendants (TBAs) to report MCH events in real time using mobile phones). With the aim of reducing delay in accessing health information and services, the mCBS system allows health workers to respond in a timely manner to obstetric emergency. The system provides a database in which reported events, responses to events and health outcomes are stored. The technologies used for the system are RapidSMS (RSMS) - an application using mobile phones which can send information across the Internet at a fast rate, and Open Data Kit (ODK) - open source software for managing mobile data collection solutions (Castle, Thompson and Karlyn, 2011). The midwives at the health facilities use the mCBs system(mobile community-based surveillance system) for weekly report of major events seen by TBAs. The system is also used by the doctors at the hospital for cases requiring urgent attention. The challenges faced by this project are lack of desire to participate in the programme by some mothers, and insufficient fund to purchase call credit by the TBAs. The problem affects the reporting of major events. According to Castle et .al (2011), the project resulted into improved access to MCH information and health outcomes, 74 total live births (87% of the community) with only 2 deaths (2.35% of the community).

This project has shown that ICT (mobile phone, computer and Internet) can be used to improve access to MCH information, reduce delays experienced by pregnant women in accessing health care and can also be used successfully by health workers with proper training for health reporting and surveillance (Thompson et. al 2010). The project identifies TBAs to be crucial, as they serve as a vital link to mothers in rural areas and the health facilities. The ODK (open-source software) which is a cheaper option and database of events played key roles to the successful

outcome of the intervention. However, the cost of making calls was a challenge to the mothers and traditional birth attendants (TBAs). Despite these limitations, mothers reported that the use mobile phones improved communication with community health workers (TBAs) and health workers at the centres. This resulted in improved care and prompt response during obstetrics emergencies (Castle et. al 2011).

The second project implemented in the northern part of the country is the Open Source Electronic Medical Record System (OpenMRS) focused on developing health information system at the Family Unit of the Shehu Idris College of Health Science and Technology (SICHST) in Kaduna, Nigeria. It was initiated by the University of California Santa Cruz. The EMRs based on OpenMRS is a complete clinical data system for collecting information on antenatal visits, labour, child health, immunisation and family planning. The EMRs allow the creation of patient records without delaying patient care (ehealth Africa Projects, 2011). The aim of the project was to determine the influence of EMRs on maternal and reproductive health care. The system provided access to patient-based health indicators at the centre and within a three months' period of implementation data errors reduced and monthly reporting process became more efficient (requiring a few seconds). It allows detailed analysis of data saves time and increases client usage of health facilities. However, two major challenges experienced during implementation were language barrier and shortage of medical record officers (Thompson, Castle, Lubeck, and Makarfi, 2010).

Despite these challenges, the EMRs focused on capturing information and data from antenatal stage, which translated to an increased operational efficiency of the clinics. This highlights the positive impact of EMRs on Maternal health as the few workers could attend to more women because the EMRs requires just a few seconds to retrieve information and report. The introduction of other ICT will definitely enhance health care delivery to mothers as experienced in the interventions discussed above.

The only e-health project found in South-east Nigeria supported by the government is the mhealth project for maternal health service at the Federal Medical Centre Owerri. The Telemedicine Unit of Federal Medical Centre (FMC), Owerri, in collaboration with Ngor Okpuala Health Centre and the Department of Computer Science Imo State University, Owerri, sought to ascertain the effectiveness of mhealth services in the reduction of maternal death (Osuagwu et al, 2012). The project set out to achieve the objectives of reducing maternal morbidity/mortality, improving the number of deliveries attended to by skilled health workers and assessing the effectiveness of MCH and patient outcomes and the quality of care delivered. To achieve these objectives, the Bamako Declaration (2001) which envisages reduction of maternal mortality rate by at least 50% was used as a yardstick. The project also targets improving access to antenatal care by 60%, improving attendance at deliveries by skilled health care professional by 70% within two years.

FMC is one of the eight facilities selected by the FMOH, NARSDA and NIGCOMSAT for pilot study. Unfortunately, NIGCOMSAT 1 lost its orbit. Therefore, the Telemedicine Unit developed m-health initiative with one of the eight maternity centres in remote areas of Umuneke in Ngor Okpalla Local Government area as a pilot scheme to improve maternal health and reduce maternal mortality (ISfTeH, 2012). This very important health facility was managed by only one trained nurse, two community health technicians and a visiting medical officer. It had a maternal mortality rate of 18%. The centre aimed to provide skilled attendance at pregnancy and deliveries, timely access to emergency obstetric care for women with complication during labour/deliveries. The m-health platform utilised these strategies to remove the three phases of delays that endanger the lives of pregnant women and their babies (Galadanci, 2008). Galadanci, (2008) in Osuagwu et al(2012), argued that these delays account for 30-40% of mortalities that are due to lack of information and adequate knowledge about signs of complications in pregnancy, accessibility problem, and cultural practices that restrict women from seeking health care promptly.

The provision of 24 hours routine call centre at the FMC is very important. The services provided include: provision of professional information, education and counselling to mothers. Mobile phones and the call centre proved vital for monitoring and rendering emergency assistance to reduce maternal mortality and to collect and transfer information and data. An enabling factor is that the cost of phone calls and running of the centre was borne by the FMC; hence poverty and financial constraints did not limit access. Overall, the project did not record any maternal death (100% safe delivery), as a result of 43.4% prompt referral. The result was not the same with the control group which recorded 10% maternal deaths (Osuagwu, Ogini, Nnodum, and Agbasonu, 2012).

The seven ICT- based MCH intervention projects in Nigeria could be referred to as pilot projects since they provide practical examples and learning grounds for making desired and sustainable progress in achieving set targets. In addition, the review of the ICT-based projects shows that using ICT for information dissemination can encourage the adoption of safe MCH practices as outlined by the World Health Organisation (2007) which can lead to behavioural changes. The review also reveals the following crucial factors that can reduce the barriers encountered in accessing quality health information by pregnant women and have significant impact on reducing maternal and child mortality. These are private/public partnerships involving governments, mobile phone service providers and NGO; strong political-will and involvement of state and local governments, mobility for health workers and ambulance to convey pregnant women during emergencies, training more health personnel to fill existing gaps in the workforce, awareness creation, information dissemination, IT skills of health workers; and robust and efficient mobile phone-internet infrastructure, supported by traditional ICT media

Given the workings of the existing MCH e-health programmes in Nigeria, a more holistic approach to MCH information dissemination is needed to harmonize strategies and lessons learnt

from the programmes, and adopt an integrated approach to addressing MCH issues. This is based on gaps identified from the seven projects reviewed. The m-health projects varied but an element they all shared was that little emphasis was placed on the period before and after conception (prenatal and postnatal). The holistic approach should implement a user-centred strategy targeted (Parmar, 2009) at meeting the information needs of mothers and their influencers, and offering timely services along the continuum of care, from prenatal, through antenatal to delivery and childhood. Besides, there must be a shift from standalone programmes. Instead, governments and stakeholders must collaborate to replicate a harmonized and integrated project covering all the stages along the continuum of care, across the country in order to realize the full benefits of ICT for MCH (Mehl, 2010).

2.3   Information dissemination methods for maternal and child health in Nigeria

UNESCO (website) defines information dissemination as a proactive information service designed to educate and inform focused groups of users on social and economic problems which require systematic planning, collection, organisation, and storage of information for its delivery to the target. The Agency for Health Care Research Quality (2012) refers to it as the distribution of information and intervention materials to a public health target audience. Information dissemination is usually carried out using various channels, social contexts and settings.

The aim of information dissemination strategies is to spread knowledge within a location, practice setting, social or other networks of end-users, such as patients or health workers. Information dissemination methods common in developing countries, include the use of the mass media (radio and television), print media (brochures, newsletters), and personal communication (workshops, group discussion), and the new methods which involve the use of recent technologies like the Internet and mobile phones (Ewards,1995).

Apart from ensuring the quality of information disseminated, it is also important to properly plan information dissemination to ensure that it reaches the target group, as its structure may differ from one health intervention to another. The ultimate goal of any information dissemination is application of such information by the target group, and its effectiveness, which is based on factors such as user's knowledge of the information, information source, channel, format, language and style of the message. Other factors affecting the application of the information include: environment and setting, education, personal capabilities and other support needed to use the information (Dwahan, 2006).

Active dissemination of information, which involves practical effort to spread information via specific channels (such as phones, digital pamphlets and mass media), has been identified to be more effective than the passive approach where information is posted on the web (AHCRQ, 2012). Scholars have identified the use of multi-faceted approach to information dissemination as most appropriate in order to increase the impact of the information disseminated. This entails the use of more than one ICT to increase the reach of the information (Grimshaw , Shirran, Thomas, Mowatt, Fraser, Bero, Grilli, Harvey, Oxman and O'Brien, 2001). This is in line with the possible action for improving the use of ICT for information dissemination recommended by Chetleym et al. (2006), who suggested the need to combine old and new ICT in innovative ways to improve the effectiveness of the use of ICT for information dissemination. Grimshaw et al. (2001) and the Agency for Health Care Research Quality (2012) also highlight the need to involve users and stakeholders when evolving m-health interventions. This is to develop information content or a message that takes into account characteristics such as the age, sex, language, level of income, literacy level and ethnicity shared by the group. This corroborates Parmar's (2009) submission that ICT use for information dissemination should be user-centred and not technology-centred for acceptability and effectiveness. This lack of user involvement is a major challenge identified by

scholars in the use of ICT for information dissemination (McNamara, 2007; Parmar, 2009; Fajembola, 2011; Asenso-Okyere and Mekonnen, 2012).

The existing methods used for disseminating information on MCH in Nigeria involve the use of radio, television, computers and mobile phones. Of all these channels, the radio has been identified as the most enduring and established, and has continued to play a central role in the development of health communication in many countries. It is an essential tool used for information dissemination, communication and behaviour modification in low income countries especially in rural areas (McConnell, Heads, Drury, Kumekawa, Louw, Fereday, Davies, Nyamai-Kisia and Nyambura, 2005). Radio has been used successfully for a number of health programmes promoting child immunisation, family planning, treating childhood illness etc. It can reach large audiences at minimal cost regardless of geographical boundaries and literacy levels. There are a lot of interactive radio programmes on topical issues like maternal and child health, Vesico Vagina Fistula (VVF), HIV/AIDs transmission in pregnancy, which most of the time, utilise other ICT and applications such as phone calls and SMS to interact with the audience and to receive feedback. Drama or playlets on topical health challenges are also recorded on audiocassettes for further outreach by NGOs (Management Science for Health, 2011; WITTS Press, 2011/2012).

In Nigeria, the Institute of Maternal health (IMCH website), in collaboration with the Rivers State Television Authority, Africa Independent Television, Nigeria Television Authority and Treasure FM radio station has continued to enlighten the public on health issues such as breastfeeding, immunisation as well as maternal and child morbidities and mortalities. Similarly, collaboration between United State Agency for International Development (USAID) and Voice of America Hausa Service has been promoting maternal and child health, child survival, reproductive health and family planning since 2004 in the northern states of Nigeria. Its focus is to promote child spacing as well as polio and routine immunization and offer practical solutions to maternal mortality, malaria and malnutrition (IMCH website; VOA/USAID Nigeria website).

The television medium is evolving as an important ICT for disseminating health information in Nigeria. Although Nigeria has fewer televisions stations when compared with radio stations, television is considered an effective tool for raising awareness and enlightening the public (NCC website). Television combines sound, moving pictures, text and graphics to capture the viewers' attention in order to educate them on healthy practices during pregnancy. The Institute of Maternal and Child Health, in partnership with Rivers State Television Authority, is running a television series tagged "Consult your Doctor"- the programme seeks to improve the health care-seeking behaviour of the public, as regards maternal, new-born and child health (IMNCH Website). In addition, some tertiary and secondary health facilities in South-West Nigeria, use programmes and documentaries recorded on CD/DVD or other digital devices to educate mothers on healthy practices during antenatal visits (Deaconess Maxwell, 2013). However, the disadvantages of television include its high cost and limited access in rural and poor urban settings. It is also limited because it is uni-directional. As a result, programmes on television are also augmented with other ICT tools. Society for Family Health and USAID, VOA Hausa service and Nigeria Midwives Scheme by the National Primary Health Care Development Agency all run programmes on television to promote maternal health and child health. Most of the programmes also have their radio versions (Blumchagen, Barker, Oladosu, Olufunke, and Reynolds, 2009; IMCH website; Murtala, 2010).

Parmar (2009) highlights the critical role of television and radio as widely accepted entertainment channels that have been in use for decades to deliver information on women's health. Chetley et al. (2006), also underscores the central role played by these media for health communication, especially in developing countries. However, Parmar (2009) avers that in spite of the roles played by these ICT tools, they are yet to evolve into a reliable information channel. The combined benefits of radio and television are still low when it comes to increasing access to information, since a lot of information users, especially those in rural areas still rely on personal

communication and see the media as a means of entertainment. Skuse (2005) in Chetley (2006) opines that the increased density of radio and television poses a potential danger. This is because there is a very high possibility for important health messages to be lost in the "Sea of media". The limitations of the television and radio nonetheless, Management Science for Health (2011) submits that both ICT will remain viable tools for information on topical health issues in Africa and other developing regions for years to come.

Personal computers are also extremely important ICT tools that can be used to strengthen health systems, advance health services, widely share and exchange health information. The use of the computer is usually associated with the intranet and the Internet. New applications(apps) referred to as social media, such as blogs, social book marking, photo/presentation and RSS, all ride on the Internet platform (Fayoyin, 2011). These new apps, also known as web 2.0 tools, allow easy access to credible and science-based health information resources in a new dimension. These technologies offer great opportunities for health promotion, as they encourage collaborative efforts amongst health workers and better engagement of patients and other audiences in a participatory manner.

Nigeria has the highest number of Internet users across the sub-Sahara African region. The rise in the number of users has been associated with an increase in the rate of penetration of the Internet and mobile phone technology.   As a result, the social media has become a valuable tool for advocacy and public awareness campaign. It provides a communication avenue which can be leveraged to promote maternal health (Management Science for Health, 2011; World Statistics, 2014). The social media can raise awareness, reach new audiences, influence policies, engage decision makers and inspire action and collaboration with partners.

Romano (2007) asserts that Internet use among pregnant women in the US is becoming common and frequent. Over 50% of women in a study reviewed by the author consulted the Internet for

pregnancy- related information. She suggests that rather than ignoring women's interest in the use of the Internet, it is better to encourage its use, as this may help reinforce content covered in childbirth education classes. However, scholars like Murray, Lo, Pollack, Donelan, Catania, and White (2003), Iverson and Howard, and Penney (2008) recommend cautious use of the Internet. They argue that if cautionary use of the Internet is not promoted, it could turn out to be a potential source of health misinformation and information overload. Other concerns identified include complication of the doctor-patient relationship with inappropriate requests, delays in effective health treatment owing to self-diagnosis, and misdiagnosis leading to adverse health outcomes.

 In Nigeria, the use of the Internet for MCH intervention is unpopular. Only two initiatives have adopted the channel for information dissemination on MCH. The channel is limited probably because of accessibility and language barrier, as women with low income and low literacy level (who do not have access to the Internet) are excluded. In addition, infrastructural problems like low bandwidth and unreliable power supply do not impact positively on the initiative and could be responsible for the low popularity of the channel for MCH interventions (Ibeh 2013; www.mamaye.org.ng; whitealliancenigeria.org).

The mobile phone technology is another ICT that is increasingly becoming an important tool in global health programmes. Mobile phones can be used by health workers (physicians, nurses, administrators, lab technicians, or community health workers) in hospitals or clinics, for monitoring health status, and easing emergencies. It may improve patients' access to, quality and utilisation of care, as well as allow patients to receive health information, skills, support, and crisis services directly for a specific health condition (Rotheram-Borus, Tomlinson, Swendeman, Lee and Jones, 2012). Likewise, many studies have highlighted the great potential of the mobile phone technology in the area of health care delivery, especially with respect to emergencies for obstetric care, health promotion, data collection and management, point of care support, disease prevention and treatment (Earth Institute Columbia University, 2010; Noordam, Kuepper,

Stekwlwnburg and Milen, 2011; Tamrat and Kachnowski, 2011). However, studies providing documentation on its application, best practices, lesson learnt and its influence on MCH practices are uncommon, especially in a country like Nigeria where the adoption of ICT for MCH is still at the early stage (Oyeyemi, 2012; Ohuruogu,Flores and Foh, 2016).

Noordam et al (2011) and Tamrat and Kachnowski (2011) also identified the need for studies focusing on the impact of mobile phones in improving the quality of m-health interventions. They stress the need for investigations to be directed towards assessing the effectiveness of ICT in the delivery of MCH care. In Nigeria, mobile phones are being used to promote MCH through programmes by government and NGOs, the Society for Family Health, Lagos, Gombe, Ogun and Ondo State Governments. Essentially, these programmes have adopted the use of mobile phones to improve the access of pregnant women to health information and services. Similarly, the mobile maternal health technology is used to support the Nigerian Midwives Scheme by the National Primary Health Care Agency (NPHCA) (Fajembola, 2011; Murtala Mai, 2010; Oyeyemi, 2012; SFH).

Cormick et al. (2012), Gurman, Rubin and Roess (2012), Noordam et al. (2011) and Tamrat and Kachnowski, (2011) have advocated the use of mobile phones for m-heatlh interventions. Musoke (2002) is of the opinion that ICT-based intervention for MCH in Africa should adopt a multi-technology approach. This view aligns with those of Grimshaw et al. (2001) and Chetleym et al. (2006) who suggest the need for a combination of ICT tools to improve the effectiveness of m-health intervention for MCH. For effectiveness of ICT-based programmes, it is important to consider the need to adopt more than one method for disseminating information for wider coverage.

2.4 Mothers' perception of ICT and disseminated information

Although studies accessing directly the perception of mothers on the usefulness of ICT and disseminated information relevance are uncommon, social influence and the technology acceptance theories clearly underscore the importance of perceived usefulness and ease of use as major factors for consideration when planning behavioural change programmes. Expression of interest in the form of demand could therefore be equated with positive perception by mothers of ICT and disseminated information. For example, the outcome of a study by Childbirth Connection (2012) in the US indicates a positive disposition by pregnant women to online health information. This implies that mothers believe that MCH information from the channel is relevant. According to the study, about 42% of the study respondents believed that online health information resources could be trusted. This was also confirmed by Romano's (2007) results from a nationwide survey in the United States(US).

The findings from the Childbirth survey indicated that pregnant women rely primarily on the Internet for their health information needs. The 4-year survey indicated that about two-third (64%) of the respondents (pregnant women) used a smart phone to access health information, and 82% have gone online via a computer system. Some of the women also reported using tablet devices (35%), regular mobile phones (33%), and iPod touch devices (21%) to get health information from the Internet. Report from another study in the same country (US) indicated a positive disposition by mothers (86.81%) to receive health tips from mobile phones. Findings from the study showed that 86.6% of the mothers who participated in the study successfully received health tips over a 6-month period and 66.1% of them requested for a call back because of the relevance of the messages. Over 80% of the mothers were happy with the messages and 75% of them shared the messages received. These results also indicate women's preference and disposition to the use of ICT for receiving MCH information (Broom, Amy, Ladley, Rhyne, and Halloran , 2015).

Cormick, Kim , Rodgers , Gibbons, Buekens, Belizán, and Althabe (2012) in a study that examined the interest of pregnant women's use of SMS (Short Message Service) for MCH care notes that pregnant women in Argentina could benefit from m-health programs. This was because the vast majority of the interviewed women had access to and were interested in receiving text messages and calls that provide relevant information and education on pregnancy and infant health.

Women in the African region have a slightly different behaviour from their counterparts in the developed countries towards the use of ICT. A survey by InterMedia (2010) on maternal and infant health programmes among young rural women in Ghana indicates that women are better disposed to receiving health information from traditional media (radio and television) and one of the most trusted sources of health information as indicated by the women who participated in the study was television and radio (70%). Similarly, Montez (2011) in Tanzania, indicated that women were positively disposed to receiving health information from mass media as this led the list of major sources of family planning and other maternal health (MCH) information consulted by women. About 72% reported radio as an important source of (MCH) information followed by television at around 40%. In South -west Nigeria, Nwagwu and Ajama (2011), observed a similar trend in women's disposition to use radio as an important source of health information. A significant proportion (90%) of participant in the study also reported obtaining health information mainly from the radio.

A study conducted in Ghana by Mechael (2009) on the use of   ICT like the mobile phone, tested the willingness of mothers to receive maternal health information via ICT channel. It showed a high demand for information and interest in the mobile phone service, which exceeded expectations and overstretched the capacity of the three operators at the call centres used for the project. All the respondents in the study (100%) were comfortable receiving MCH information via mobile phones (Grameen Foundation 2011). Statistics from a project executed by the Society for

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Family Health (SFH) in Gombe also indicates a positive disposition to the mobile technology. The aim of the project was to improve critical MCH practices in rural areas, using call centres and MCH hotlines to help health workers and families manage MCH issues. Within four months of the project initiation, 24989 calls were received; of which 11709 were enquiries related to maternal and neonatal health. In addition, over 50% of the callers were first- time mothers, and about 400 women called back to say 'thank you' for the information and support they got through the centre (Onoriode , Otunomeruke, Ofuogbu, Mohammed, and Anyanti, 2012).

Balogun , Sekoni, Okafor, Odukoya, Ezeiru, Ogunnowo, and Campbell (2012) in a study at a tertiary health facility in Lagos, Nigeria, also reported that access to mobile phones by mothers superseded their access to the Internet and they were positively disposed to receiving SMS to remind them of immunisations. However, they exhibited unwillingness to bear the cost of SMS. This point to the fact that mothers' perception of ICT disseminated information was positive. Furthermore, Parkkola (2006) highlights the importance of exploring mothers' view in a study tagged "Designing ICT solution for mothers: User Psychological Approach". The study revealed the attitude of mothers to technology, as well as their media choice. Results from the investigation reveal a positive disposition by mothers to use ICT and even implement a new one, once they are convinced of its usefulness. This implies that mothers will adopt a technology once they can obtain benefits from it. The researcher submitted that the demand and attitude (disposition) to use ICT by mothers were closely related. The study also indicates that the motive to use ICT is based on the needs and the characteristics of available ICT tools. This ultimately, affects the use of ICT by mothers to access health information. This positive stance was also confirmed by Lemish and Cohen (2005) in a study in Isreal which indicated that women were positively disposed to use mobile phone in the same manner as men. The study also showed that internalising the use of mobile phones and adopting it in everyday routine is related to the growing positive perceptions towards it by men and women. Similarly, Ojokoh, Zhang,

Oluwadare and Akintola (2013) in a study on women's perceptions and uses of ICT in Nigeria and China found that women were positively disposed to embrace the use of ICT. However, women from both countries are of the opinion that they need to be trained to be successful with the use of ICT. This same view was corroborated by women in the Vietnamese, Sudanese and Samoan communities in a study supported by Institute for Community, Ethnicity and Policy Alternatives (ICEPA) and the Victoria University in Australia. Women who participated confirmed the need for training on the use of ICT to ensure success in the use of ICT to for receiving and communicating health messages (ICEPA, 2010). Brown, Oluwatosin and Ogundeji (2015) at the University College Hospital in Ibadan, Nigeria also reported a positive disposition in a study where 95.1% of the mothers who participated in the study expressed willingness to receive appointment reminders from their cell phones. Only 4% of the mothers were not willing to receive any information on immunisation from their cellphone

The positive attitude of mothers observed in the previous studies cited varies from the findings of previous studies. Tiainen (2002) and Oksman (2003) studies revealed a negative disposition to ICT by Finnish women. An ICT-based project in Somolia which involved the use of mass media for promoting immunisation highlights also the negative perceptions mothers had towards health messages disseminated to promote immunisation. According to the mothers, these messages failed to inform, educate and motivate mothers to adopt healthy practices. This was because the messages failed to establish connections between the vaccines promoted and disease prevention (La, 1992). These results further underscore the need to pay attention to mothers' view on health messages promoted by ICT-based projects to ensure effectiveness.

Castle, Thompson, Karlyn (2011) in a study in Kaduna State, Nigeria also revealed a negative disposition by mothers to use of mobile phones for receiving MCH information. As a result, most of the mothers lacked willingness to participate in ICT-based projects for MCH in the rural communities of the State. In Belgium, Broos (2005) in a survey on gender and ICT anxiety

reported a negative disposition by women towards ICT unlike the men who participated in the study. The women who were involved in the study had negative attitudes towards computers and the Internet. But they were more comfortable with the traditional media (radio and television).

In spite of the growing body of literature on the acceptance of recent ICT channels (Internet and mobile phone) as sources of maternal and child health information, studies have shown that women still prefer the traditional media (radio and television). The studies reviewed indicate the need to be cautious in the deployment of new technology for dissemination maternal and child health information. This is because the available ICT channel may not be the most preferred source of health information. Likewise, the current or more recent source may not be the most used as available evidence indicates that women in developing countries seem to be more positively disposed to the use of the traditional media, especially the radio as source of maternal and child health information.

The Unified Theory of Acceptance and Use of Technology (UTAUT), illustrates how the perceived usefulness of information disseminated could have profound influence on health information seeking behaviour, which is further influenced by the ease of use and convenience of the type of ICT tool (Venkatesh, Morris, Davis and Davis,2003). Kijsanayotin and Pannarunothai (2009) were among the first set of scholars to adapt this intention-based theory to predict the use of ICT for administrative purposes when implementing e-health projects in Thailand. The results from the study indicated that intention to use e-health services is a function of the perception that e-health services is useful (perceived usefulness), that important others believe he or she should use it (social influence), and the perception that one has the choice to use ICT. Therefore, willingness to use technology as source of health information may be dependent on mothers' perception of the channel and information emanating from this source. This can have significant influence on the adoption of information from such channel, thus highlighting the relevance of disseminated information on maternal health practices of mothers.

Therefore, it is important to investigate the perceptions of mothers when evolving ICT-based programmes for MCH to ensure acceptance of MCH information and use of ICT channel for information dissemination. Because this can make or mar the effectiveness ICT-based projects.

2.5 Maternal health practices in Nigeria

This section presents some orthodox practices as outlined by World Health Organisation and traditional/unorthodox practices. It further examines studies that show the adoption of safe MCH practices, like family planning, early registration, antenatal visits, skilled birth attendance and delivery in health facilities, exclusive breastfeeding and immunization.

While motherhood is usually a positive and fulfilling experience, it is associated with suffering, ill-health and even death. For many women major direct causes of maternal morbidity and mortality include infection, hemorrhage, unsafe abortion, high blood pressure and obstructed labour (Adamu, 2011). Maternal health Care Practices (MCHC Practices) refer to both modern (based on orthodox medicine/scientific) and traditional (Based on unorthodox medicine/cultural beliefs) conducts and actions of the health practitioners and the mother that are aimed at preventing unwanted conception, ensuring safety precautions during pregnancy and childbirth, and beyond (World Health Organization, 2012).

Over the years, orthodox medicine has evolved practices that are based on data, facts, evidence, and experiences. Its prescriptions and adoptions are result of clinical studies and experiments. It involves procedures, precautions, actions, standardized medication, scientific testing and evidence based diagnosis. On the other hand, the unorthodox practices are often based on assumptions, traditional and non-standardized procedures, recipes/concoctions (in diet and for medication), as well as spiritual, cultural and belief systems. Ultimately, the main aim of both

modern and traditional MCH practices is to ensure the total well-being of the mother and the child during and delivery (World Health Organisation , 2012).

Unfortunately, many casualties and deaths have resulted from misinformation, lack of information, lack of access to modern antenatal care, shortage of doctors, midwives and skilled birth attendants. The traditional methods often result in complications and are responsible for a significant proportion of maternal and child deaths (Federal Ministry of Health 2011). This is because the traditional methods are mostly based on myths, superstitions, religious and cultural beliefs. The situation is further compounded by unskilled birth attendants. Some harmful practices entail upholding food taboos, the taboo of not going out at midday and in the night, consuming harmful concoctions/herbs, error of attribution of deaths and mortalities to the *Abiku* belief.

Regarding pregnancy and food taboos, women were warned not to eat large plantains so as not to give birth to babies with rigid skulls. Many traditional healers in the Yoruba land also discourage women from eating snails, snake and okro, as these would have adverse effects on the babies. They are warned not to take milk and egg to avoid the baby growing up to become a thief. It is also believed that a pregnant woman who is discourteous in her relationships, especially with her husband may experience excessive bleeding (Muoghalu, 2012). Among the Urhobo in Nigeria, a pregnant woman is expected to consume food left over from a rat to ensure safe delivery. Similarly, in Ishan, Edo State, Nigeria, young mothers must not consume oil, meat and palm-nut soup until thirty days after delivery (Meyer-Rochow, 2009). Likewise, in Ifewara, Osun State after delivery, mothers are not expected to eat salted food until the 8th day.

Among the Hausas in the northen part of Nigeria, women, especially first timers are exposed to a traditional surgical operation (*Yankan Gishiri*) to prevent prolonged labour. The 'surgery' is carried out by traditional birth attendants (TBAs), local herbalists, or barbers. It involves cutting the anterior or the posterior and lateral walls of the vagina. Complications that

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often arise from this harmful practice are severe bleeding, excruciating pain, vesico vaginal fistula, HIV infection, hepatitis and painful sexual intercourse in the immediate future (Dahiru, 2009).

Another harmful practice is *wankan Jego.* This is a typical practice amongst the Hausa in Nigeria. The practice requires a new mother to take two hot baths each day to keep warm using a bundle of leaves to splash very hot water on her body. After taking the bath, the mother stays in a well-heated room with a fire or fire glowing underneath a specially constructed earthen bed, which can absorb and retain heat for a long time. A concoction, prepared from guinea corn or millet spiced with potash and pepper is taken repeatedly, to increase the flow and quality of breast milk. This continues for about 40 to 120 days. The potash refers to as *Kanwu has* high sodium content but very little potassium and can lead to hypertension and heart failure. Complications that may occur as a result of the practice include burns, eclampsia and heart failure (Dahiru, 2009). These unsafe practices could be reduced significantly if vital information on safe MCH practices is placed within the reach of pregnant women and their influencers.

The World Health Organisation (2007) recommended standard MCH practices Such as regular antenatal and postnatal visits, family planning methods, nutrition in pregnancy, breast feeding and child immunisation. They also include health practices such as routine delivery and referrals practices by health workers. Other standard MCH practices recommended by the World Health Organisation include the uptake of two doses of Tetanus injection by mothers one month apart before delivery, or an uptake of five doses before delivery, in situation where their medical records are not available. They are also supposed to have access to accurate information on the prevention and recognition of sexually transmitted infections (STIs) and reproductive tract infections (RTIs). In areas with high prevalence of malaria, it is important for all pregnant women to sleep under insecticide treated nets (ITN) and to avoid malnutrition. They should routinely take iron and folate supplements and appropriate dietary advice, to prevent anemia (WHO, 2007). All

women giving birth and their newborn babies should be protected against tetanus, to prevent maternal and neonatal tetanus (MNT). Tetanus toxoid should be administered to them even when her immunization status is unknown. Pregnant women should receive two doses of TT/Td one month apart before delivery, and further doses as stated in WHO standards when record history is not available. She should receive five doses before delivery, in a situation where her medical history is available.

The level of adoption of these practices as outlined by WHO may be inferred from empirical studies conducted in Nigeria. Kabir, Iluyasu, Abubakar and Sani (2005), in a qualitative study in Kano, discovered that the level of utilization of antenatal services by women of childbearing age is related to the educational qualification of the women and that of their husbands. The study reports that the majority of the women (86%) who utilised ANC services attained either secondary school or post-secondary school education. In a similar study in Ibadan Dairo and Owoyokun (2010), found that although the utilisation of antenatal services was high (76.8%) in South-western Nigeria, by Christian women and younger mothers ranked low in patronizing antenatal care. Muslim mothers and women in other religions were more likely to attend ANC clinic than women who were Christians. Furthermore, women who were 25 years old and above have a higher chance of utilising antenatal services more than those who were below 25years old or younger. The scholars recommend the promotion of modern ANC care in religious settings and amongst younger women, especially in the rural areas to ensure that ANC services are utilized by mothers.

In another study on the health-seeking behaviour of mothers, in the southern part of Nigeria, Osubor, Fatusi and Chiwuzie (2006) discovered that only a few out of the 225 women randomly selected for the survey adopted safe MCH practices. Findings from the study showed that only 9.9% received antenatal care, 6.2 % received tetanus toxoid, while only 4.9% attended

postnatal clinic. The scholars also found education to be significantly related to place of delivery, but no association was found between age and marital status.

Similarly, Onasoga, Afolayan, and Oladimeij (2012) in a study carried out in Osun State revealed that about 58 (56.9 %) of the 102 respondents recruited for the study attended ANC regularly; 56 (57.1%) booked for antenatal care in the first trimester; and attended on appointment days after booking. The study identified the following as major factors influencing the utilsation of antenatal services: affordability of antenatal services, schedule of antenatal appointment, lack of knowledge about the existing ANC services and husband's acceptance of the services rendered. There was a significant association between distance, religion, knowledge, marital status, and educational qualification of respondents and their utilisation of ANC services. This result partly corroborates the work of Nwosu et. al (2012) who found, in a national survey, that household wealth status has significant positive effects on the number of visits before delivery in Nigeria The study confirmed the positive relationship between educational qualification and the number of ANC visits.

On the use of contraceptives for family planning among the Yoruba in South-west Nigeria, Ogunjuyigbe et. al (2009) established the importance of husband's support for women in adopting healthy practices, especially family planning methods. The study observed that men have a significant role in the adoption of contraceptives. About 37% of the respondents reported joint decision- making on when to have another child, 40.8% on whether to stop having children, and 44% on what to do to stop childbearing. The authors recommend the need to promote communication between husband and wife on reproductive matters to improve the adoption of contraceptives and male participation in family planning. Their findings corroborate the work of Onasoga et. al (2012). Odusina, Ugal, and Olaposi's (2012) investigation on contraceptive in a state in south-western Nigeria shows that high level knowledge of contraceptives among respondents does not necessarily translate to high contraceptive usage. Only about a third of the

participants claimed to be users of contraceptives. The study reveals a relationship between contraceptive use, age and religion.

Furthermore, studies have shown that the rate of adoption of another important MCH practice, exclusive breastfeeding (EBF) by mothers in South-western (S/W) Nigeria is low. Agunbiade and Ogunleye's (2012) work on breast feeding habits of mothers in S/W reveals low level of adoption of the practice, as only 19% out of the 200 mothers that participated in the study practiced exclusive breastfeeding. Major hindrances to practicing exclusive breastfeeding identified by the study are the belief that babies are not satisfied with breast milk alone, maternal health problems, fear of babies becoming addicted to breast milk, coercion from mother-in-law, sore nipples, and the need to return to work. The study also argues that influencers, such as husbands and mothers-in-laws played vital roles in encouraging exclusive breast feeding(EBF). Conflicting positions or support by these influencers was a dominant constraints reported by mothers who took part in the study.

Similarly, Agho, Dibley, Odiase and Ogbonmwan (2011), in a national survey using NDHS data of 658 children, discovered that the average exclusive breastfeeding feeding (EBF) rate among infants younger than 6 months of age was 16.4%. The odds against exclusive breastfeeding were higher in rich households than poor ones. Mothers who had four or more antenatal visits were significantly more likely to engage in exclusive breastfeeding and female infants were more likely to be exclusively breastfed than male infants. Also it was found that mothers who lived in the North Central geopolitical region were significantly more likely to exclusively breastfeed their babies than those mothers who lived in other parts of Nigeria.

Oladokun, Lawoyin, and Adedokun (2009), reported low uptake of primary immunization among children of female market traders in South-western Nigeria. Only 40.7% out of the 418 women recruited for the study completed the routine child immunization, while 8.4% had never been

immunized. The highest vaccine uptake reported was BCG (91.4%), while Hepatitis B (1%) had the lowest uptake. DPT1 to DPT3 vaccine drop-out rate was 32.1%.

Definitely, there exists a strong correlation between unsafe MCH practices and high maternal and child deaths in Nigeria. The studies reviewed also shows that social status, income, education, influencers (husbands), religion, tradition, and knowledge of safe MCH practices have strong influence on health outcomes in maternal health programmes. These issues could be addressed efficiently through the use of information communication technology to disseminate information, access patients' information and provide care at all the stages of care; instead of focusing on one stage along the continuum of care as is the norm in most of the ICT-based interventions.

2.6. Health Workers use of ICT for information dissemination and maternal health practices

This section focuses on the use of ICT for MCH information dissemination in ICT-based projects and its influence on MCH practices. A significant proportion (83.4%) of ICT-based projects for MCH reviewed by this study used mobile technology for MCH information dissemination. The outcome of the e-health projects shows that the use of ICT by health workers for information dissemination on MCH is a strategic move that can help curb high mortalities. The Open Source Medical Record System (OpenMRS) project used computer systems in the provision of information on antenatal visits, labour, child health, immunisation and family planning in Kaduna, a northern state in Nigeria, which was used to support decision making by health workers. The Malahfiya project in Abuja also used Intel-powered note books to collect and disseminate patients' data, including pictures (Intel, 2012; Thompson, Castle, Lubeck, and Makarfi, 2010).

Other ICT-based projects like ,LigneVerte intervention in Congo, MOTECH in Ghana, RapidSMS for mothers and new-borns in Rwanda, Every Child Counts in Kenya, Chipatala Cha Pa Foni (CCPF) in Balaka District in Malawi, Cell-life for mothers in South Africa, Gambia

intervention for MCH and the Abiye project in Ondo State, Nigeria all used mobile phone technology for the delivery of MCH information (Corker, 2010 ; Cole-Ceesay et.al 2010 ;Berg et al, 2010 ; Grameen Foundation 2011;; Kalach, 2011; Innovations for MNCH, 2012; Oyeyemi 2012; Ngabo et al, 2012). Apart from the *Abiye* project and the Gambia intervention which used the mobile phone for communication in emergencies, all the other interventions reviewed disseminated information on MCH in either voice or text format.

For example, the *Chipatala Chapa Foni* project in Malawi disseminated MCH information such as personalised health messages supporting timely and appropriate care-seeking and health practices by mothers. Practical information was also disseminated to health workers to support patient management and provision of quality care. While confidential and accurate information on family planning was promoted using call centres in the LigneVerte project, in the Republic of Congo, the Rapid SMS in Malawi and Kenya disseminated information on appointment reminders and child nutrition. Information on nutrition screening, measles vaccination and child registration to support health workers' decision making process were also disseminated in a project tagged "Every Child Counts MVP" in Kenya (Corker, 2010 ; Cole-Ceesay 2010; Berg et al, 2010; Kalach, 2011; Innovations for MNCH, 2012; Ngabo et al, 2012).

Another applications of ICT as reported in Ghana, is the MoTECH project which involved the provision of time-specific information or reminders each week in the local dialect for specific treatments. Educational information on fetal development, good health practices, breastfeeding and counsel on challenges during pregnancy was also provided. In addition, tips for saving money for transportation to health facilities for delivery and requirement for birthing kits and nutritional information in pregnancy were also provided by the project using the mobile phone. See boxes 1 and 2 in the appendix for sample messages delivered to a pregnant woman in the 5th and 13th week of pregnancy (Grameen Foundation 2011).The forgoing studies revealed that the information

emanating from ICT channels increased women's awareness of health issues and encouraged them to use available health resources to stay healthy throughout pregnancy and care for their children.

Apart from increasing women's awareness about health issues surrounding pregnancy and child birth, phone consultations equipped women with knowledge for making informed decisions about their health and that of their children. As a result, mothers were able to manage health issues before getting medical help. This is evident in the Chipatala Chapa Foni project in Malawi where an increase in the home-based management of common health conditions in women and children was observed. For example, more families used mosquito nets to protect children and pregnant women from malaria. The project was able to help in bridging the gap in health service delivery. This is because women in rural areas, who otherwise would have been unreached, were able to interact remotely with the health system without having to travel long distance before getting access to healthcare. The results from the project evaluation showed that 98 % of them were satisfied and 77% very satisfied with the health tips received. (Innovation, 2011; Cooper, 2013).

Likewise, the LigneVerte project in Congo provided information on family planning using a call centre. From 2005 to 2008, the project received approximately 80,000 calls, out of which over 80 % were from men. As a result, the authors exercised concern over the effectiveness of the intervention because more calls came from men. This may be an indication that the programme did not reach the most important target group (women) (Corker, 2010). Another pilot project in rural Mozambique also used mobile phones for disseminating information. Women in the intervention group of the experimental study were exposed to the use of mobile phones for disseminating MCH information and were compared to the control group. The results from the pilot study showed that the percentage of mothers who knew at least 2 danger signs in pregnancy was significantly higher in the control group (68 %, OR 0.4, p value = 0.009) than in the intervention group (51.6 %). The proportion of mothers who

knew danger signs in the postpartum period was fairly low in both groups, but that of the intervention group (11.8 %, OR 0.4, p value = 0.05) was significantly higher than that of the control group (5.3 %) (Rema, 2013).

A study by Grameen Foundation (MoTECH, Ghana), intended to test users' willingness to receive maternal health information through a mobile phone revealed a high demand for information and interest in the mobile phone service, which was far greater than expected and overstretched the capacity of the three operators at the call centres used for the study. All the respondents in the study were comfortable receiving MCH information via mobile phone. Overall, the articles reviewed revealed improved access to health information and MCH practices (Grameen Foundation 2011).

Musoke (2002), observed that a significant effect of use of ICT for MCH in Uganda was its positive influence on mothers' health-seeking and reproductive outcomes. As a result of the use of ICT, health workers were able to communicate better, referrals were easier and the reputation of health workers improved. This positive influence of the use of ICT on health workers' reputation led to an increase in the number of women seeking quality health care. Cooper (2013), reporting an evaluation of the impact of an ICT-based project for MCH (Chipatala Cha Pa Foni Project -CCPF) in Malawi by Health System Group, involving women, their partners and health workers observed a positive influence on the MCH practices of mothers as a result of the use of ICT by health workers. This included adoption of healthy practices such as exclusive breastfeeding of infants and improvement in nutrition practices of pregnant women.

The use of ICT (computers and mobile phones) by health workers also equips them with practical information for improving patient management and quality of care. This was evident in the RapidSMS project for MCH in Rwanda and Open MRS system, where useful information about patients was provided to health workers. ICT use had a positive influence on the response time of health workers as it enabled doctors and midwives to promptly respond to patient needs,

especially in emergencies. This eliminated delay normally experienced in patient care and improved the ability of health workers to provide quality care and service to patients (Kalach, 2011).

Primarily, the first stage of delay (delay in deciding to seek care by the pregnant women) and the third stage of delay (delay in receiving care at the health facility) are reduced with m-health interventions. For example, the Abiye project in Ondo State, Nigeria allowed women and health rangers equipped with tricycle ambulance to make free calls using Abiye phones distributed free by the government. This enabled all stakeholders involved in the project to communicate easily to facilitate referrals in cases of emergency. This countered the third and first phases of delay to getting health care encountered by pregnant women. (Fajembola, 2011; Oyeyemi, 2012). Equally, sending appointment reminders and information on vaccination, as observed in MOTECH, RapidSMS, Chipatala Chapa Foni and Every Child Count projects influenced mothers to attend more antenatal and postnatal session. As a result, there was an increase in the number of facility deliveries (Berg, Wairiero and Modi, 2009; Kalach, 2011; Grameen Foundation 2011; Innovations for MNCH, 2012).

The use ICT for MCH care also led to improvements in patient management and quality of care. As found in the Mobile Community-based Surveillance (mCBs) in Nigeria where health workers respond in a timely manner to obstetric emergencies, the system provides a database in which reported events, responses to events and health outcomes are stored. The technologies used for the system are RapidSMS (RSMS), an application using mobile phones, which can send information across the Internet at a fast rate, and Open Data Kit (ODK) for managing mobile data collection solutions. The midwives at the health facilities used the mCBs system for weekly reports of the major events seen by (TBAs). This equipped hospital health worker with practical information about the patients for prescriptions and prompt diagnoses (ehealth Africa Projects, 2011). As a result, the project recorded improved health outcomes: there were 74 total live

births (87 % of the community) with two deaths (2.35 % of the community). Staff at the hospital also reported being able to give accurate reports without human errors in addition to the timely generation of detailed analyses of data obtained from the patients. However, input errors and an overload of input data were recorded. These might have affected the observed outcomes. Likewise, the RapidSMS programme for MCH in Rwanda provided useful information about patients for health workers at the facility. It allowed doctors and midwives to respond promptly to patient's needs, especially in emergencies. As a result, delays normally experienced in patient care were eliminated. This also built the capacity and improved the decision-making ability of health workers (Kalach,2011; Thompson et. al, 2010).

In Project Nwana in Zambia, mobile technology was used to speedily deliver test results for the diagnosis of HIV in infants to rural clinic. It also facilitated communication between clinics and community health workers. Observations from the health facilities involved in the project indicated that the results of the HIV tests were 50 % faster and the number of results arriving at the health facilities increased   by 30%. There was also an indication of improvement by approximately 75 % in the survival rates among HIV-positive infants who started treatment within the first 12 weeks of life. However, no relationship between the faster turnaround time of results and early Anti-Retroviral Therapy (ART) access for exposed infants was established. Additionally, the authors mentioned that it was too early to know the impact of messages sent via mobile phones on treatment adherence or postnatal appointments (Partnership Profile, 2012).

The forgoing projects reveal the influence of ICT use on maternal and health practices. The use of ICT for MCH care influenced mothers to adopt healthy MCH practices (more frequent attendance at antenatal/postnatal clinics), improved communication between patients and health workers, increased efficiency of health workers and improved access to MCH information and care by mothers.

The implementation of m-health project for MCH increased the number of skilled-birth deliveries. For instance, the Abiye project in Nigeria equipped community health workers with mobile phones; this enabled them to make more referrals, hence increasing facility deliveries. This translated to reduction in maternal death by 30% (Fajembola, 2011: Daily Times, 2012). Similarly, in Rwanda, the RapidSMS project led to an increase in antenatal visits and utilisation of health facilities, because appointments reminders and alerts on child nutrition were sent to mothers' phones. Consequently, facility deliveries increased from 342 per month to about 400 per month. The number of home deliveries was also reduced from 104 per month to 65 per month. This resulted in a decrease in maternal and child mortality in this location (Kalach, 2011; Ngabo et al., 2012; Oyeyemi, 2012).

2.7 Mothers' perception of ICT- disseminated information and maternal health practices

According to behavioral change theories, perception of an information system by the target audience plays a great role in determining the attitudes and responses to messages being disseminated. Hence perception of information on MCH practices emanating from ICT channels by mothers could play a vital role in influencing mothers' adoption of safe maternal and child health practices.

Despite the relevance of perception in effecting behavioral change it is pertinent to note that there is a dearth of studies that directly assess the perception of mothers on the usefulness of ICT-disseminated information. Nevertheless, mothers' perception could be deduced by applying social influence and the technology acceptance theories which clearly underscore the importance of perceived usefulness and ease of use as major factors for consideration when planning behavioural change programmes (Davis et.al,1989; Venkatesh et. al ,2003).

Therefore, mothers' gravitation towards ICT-disseminated MCH information is a demonstration that they find the channels useful and the information relevant. This aligns with technology acceptance theories, and therefore could be equated with positive perception by mothers of ICT disseminated MCH information. Likewise, inferences could be drawn from the positive results recorded owing to the adoption of safe MCH practices. This section, therefore present literature indicating mothers' use of ICT as source of information on MCH and their participation in ICT-based projects as indicators of their perception of information from ICT as well as their adoption of safe MCH practices.

The second volume of the mHealth compendium by USAID/Arlington presents twenty-seven case studies of mhealth applications being implemented mainly throughout Africa. It also documents case studies on behavioral change communication projects on maternal and child health from other regions. This report provides evidences on mothers' gravitation towards ICT-based projects and willingness to receive MCH information, and adopt safe MCH practices. For instance, the Mobile Alliance for Maternal Action's (MAMA) program in Bangladesh tagged *Aponjon* (meaning dear one in Bangla) registered 1,000 subscribers at take-off. About 60% of mothers who subscribed to the service had their own phone, while about 40% women enrolled through gatekeepers or a family member's phone. The messages disseminated enabled improved household practices with respect to nutrition, antenatal care visits and preparation for delivery. As at 2013, over 52,000 mothers and guardians have subscribed to *Aponjon*. This is a clear indication of women's gravitation towards mobile phone massaging services and adoption of healthy behaviours. Similarly, the MAMA project in South Africa disseminated information via mobile phones to mothers on early commencement of antenatal care, exclusive breastfeeding for HIV-positive mothers, and assisted them to understand how to prevent transmission to their babies. As at April 2013, over 17,500 women had subscribed to, and used the services of MAMA in South

Africa (UBS Optimus Foundation, 2011; Gayle Mendoza, Lungi Okoko, Gwendolyn Morgan, and Sarah Konopka, 2013).

The *Wazazi Nipendeni* (Parents, Love Me) project in Tanzania, a national multi-media campaign, operationalised as Tanzania's Campaign on Accelerated Reduction of Maternal Mortality (CARMMA TZ) is another notable project. The project implemented an SMS-based service that empowered pregnant women and their partners to take the steps necessary for a healthy pregnancy and safe delivery. The program was developed by the Johns Hopkins Bloomberg School of Public Health Center for Communication Programs and led by the Ministry of Health and Social Welfare (MOHSW). The campaign integrated all safe motherhood areas, including early and complete antenatal attendance, malaria prevention, prevention of mother to child transmission (PMTCT), individual birth planning, and safe delivery. The *Wazazi Nipendeni* text message service reached 100,000 active registrants, and sent out over four million text messages to those who signed up for the free healthy pregnancy and safe motherhood information between November 2012 and March 2013. (Gayle Mendoza, Lungi Okoko, Gwendolyn Morgan, and Sarah Konopka, 2013).

In Uganda, a positive gravitation towards MCH information and adoption of safe MCH practices was also reported in the Rescuer project. As indicated by Musoke, mothers' acceptance of MCH information from simple ICT influenced their adoption of safe MCH practices or an improvement in their health behaviours. The *Chipatala Cha Pa Foni* Project -CCPF in Malawi by the Health System Group, targeted at women, their partners and health workers also recorded positive acceptance of ICT-disseminated MCH information as well as the adoption of MCH practices such as, exclusive breastfeeding of infants and improvement in nutrition practices of pregnant women (Cooper,2013). Similarly, in Rwanda, the RapidSMS project sent text messages on appointment reminder and information on child nutrition to mothers. This led to an increase in antenatal visits and utilisation of health facilities, consequently, resulting in the adoption of safe

MCH practice and reduction in maternal and child mortality in the location (Kalach, 2011; Ngabo et al., 2012; Oyeyemi, 2012).

In Nigeria, between December 2012 and December 2013, over 2,400 pregnant women registered and were tracked through the CommCare project for MCH in Abuja. The registered mothers indicated a positive perception of MCH information and were also willing to adopt healthy practices. Likewise, the Abiye project in Nigeria equipped community health workers with mobile phones which enabled them to disseminate MCH information to mothers which encouraged them to adopt safe MCH practices (Fajembola, 2011: Daily Times, 2012). Equally, in 2010, Parma in a study involving the dissemination of maternal health information to rural women reported that the user -centered approach to designing ICT-based project recorded a significant improvement in knowledge level of rural women. This encouraged them to adopt healthy practices during pregnancy.

The cited literature on ICT-based interventions document evidences of the use of ICT by health workers to disseminate MCH information and the positive affinity of mothers towards ICT, especially mobile phones. As stated earlier, studies assessing perception directly from mothers' standpoint are uncommon. Consequently, from logical synthesis of the cited literature, using mothers' responses and observations of behavioral changes (adoption of safe practices) as yardstick for perception, reveals a positive perception of mothers towards ICT disseminated MCH information and a growing proportion of subscribed mothers leaning towards positive behavioral changes and adoption of safe practices.

2.8   Challenges of e-health project implementation and acceptance

Challenges of e-health project implementation such as technology, language, cultural literacy impact and acceptability, call for collaborative strategies in developing and disseminating MCH information using ICT. This is to make sure that technological innovations are accepted and

actually used. Silva and Dias (2007) assert that the acceptance and use of information technologies as well as the user's behaviour toward them will continue to attract the attention of researchers. This is because of the assumption that a particular technology would be used once it brings competitive advantages to the organisation or the individual. Although, this idea is in line with the first premise of Davis's et. al (1989) Technology Acceptance (TAM) Model which states that users' acceptance of a technology is based on perceived usefulness, this may not necessarily be true as the second premise of TAM also underscores another determinant: ease of use of technological innovation.

Davis's concept essentially states that apart from perceived usefulness, the ability to understand and use technology is an important factor that will determine whether a target audience will accept a technology or not. In other words, ensuring the acceptability of ICT tools to target audience and the ease of use of the tools to ensure that technological innovations are accepted and used is important when evolving ICT-based interventions for MCH. Hence, identifying what device or ICT channel and format would be appropriate considering the level of income, literacy, and IT skill is crucial. In addition, the acceptance variables need to be well comprehended, to avoid wasting time and resources during the development of information technology applications and programmes for MCH interventions. It is therefore, essential to study the target audience. This is to determine what device and format will be applicable for disseminating MCH information in the setting under consideration (iheed, 2011).

Another barrier that could affect the effectiveness of m-health for MCH identified by Mechael et al. (2010) is language. The scholars observe that it is very important for designers and developers of ICT-based intervention on maternal health to always put into consideration the language of the target audience. Developing interventions with the intended audience's level of comprehension and not only including user-friendly ICT tools, but also putting into consideration the language of the audience will help promote the adoption of healthy practices and foster greater

behaviour change (Gurman, Rubin, and Roess, 2012). With the exception of radio and television programming, the issue of language is neglected most of the time in ICT programmes. Most offer very little content in local languages. This could be a major barrier when adopting ICT for MCH in Nigeria. Sub-Sahara Africa has many languages and dialects. For example, South Africa alone has 11 official languages. Most of the health information materials available on the web are written in English and not in any of the official languages; and most current ICT applications designed to facilitate knowledge exchange are also not in the local languages (Gathoni, 2012; Management Science for Health, 2011). A country like Nigeria, with over 300 ethnic groups may find it difficult to reach the uneducated, especially those in the minority ethnic groups.

The need to come up with strategies to overcome language and literacy barriers to ensure effectiveness of m-health programmes cannot be over emphasised. Google is one Internet platform that is succeeding in providing such services in as many languages as possible. This improves health workers' capacity to effectively deliver health information (Chetleym, Davies, Trude, McConnell, Ramirez, Shields, Drury, Kumekawa, Louw, Fereday and Nyamai-Kisia, 2006; Earth Institute Columbia University, 2010; Adamu, 2011; Management Science for Health, 2011).

It is important to understand the target group and all stakeholders or influencers in the setting where ICT- based intervention will be implemented. They should be consulted when evolving e-health programmes for specific communities. This is to develop health information content that aligns with socio-cultural contexts which shape behaviour, cultural attitudes, and ICT readiness. All of these affect the ability of users to embrace new technologies, comprehend and use information emanating from such medium (Gurman, Rubin, and Roess, 2012). According to Parmar (2009) ICT interventions have mainly been technology-driven rather than been user-centred. This is because designers of ICT-based programmes have focused on finding applications of already developed interventions for the rural communities rather than understanding the users'

needs and context. Projects involving users from the initial development phase are uncommon. This has resulted in the low acceptance and use of ICT tools by the target groups and a negative influence on the adoption and implementation of e-health projects. Likewise, Ashok and Beck (2007) submitted that there is rarely an opportunity for rural users in developing an information system. Especially when creating or adapting locally relevant content. This according to Parmar (2009) may be responsible for the inability of rural users to relate to the information content provided at times by ICT programmes. Most interventions mainly provide general health information services rather than domain specific applications. Gurman et al. (2012), in their review of m-health focusing on behaviour change communication also mention the need to develop message content tailored towards specific audiences, instead of disseminating the same message to the highly literate, semi-illiterate and illiterate target groups.

The policy paper by the Earth Institute University of Columbia (2010) on barriers and gaps affecting m-health in low –and- middle-income countries underscores the need for a better understanding of context and culture to evolve effective mobile health programmes. Similarly, a report by iheed (2011) stresses the need for content of m-health messages to be developed in a collaborative way, sharing best practices. Disseminating health information that aligns with cultural context is important because poor message content can have negative unintended effects. For example, the use of mobile phones in Ghana affected the clinical system in a way which brought up a number of political and cultural issues. Hence, a good understanding of cultural contexts and strategies to overcome language and literacy barriers is needed to evolve effective e-health projects (Grameen Foundation 2011; Källander, Tibenderana, Akpogheneta, Strachan, Hill, Asbroek, Conteh, Kirkwood, and Meek, 2013).

Another challenge to the acceptance and implementation of ICT-based project is the cost burden associated with the use of ICT for health care. Aranda-Jan, Mohutsiwa-Dibe and Loukanova

(2014) in a review of mhealth projects in Africa, identified limited funding opportunities to subsidise the cost burden associated with the use of ICT as a major barrier affecting the effective implementation and sustainability of ICT-based projects in the continent. They reported that the cost associated with the provision of ICT infrastructure, as well as the use of such facilities is prohibitive, especially for nationwide emergency call centers. A study conducted in Lagos State Teaching Hospital by Balogun et al. (2012) underscored cost as a major issue when using mobile phone for disseminating MCH information. The result of the study indicated a positive disposition by health workers and mothers to the use of ICT for receiving MCH information. But revealed that they were not willing to bear the cost of messaging services (SMS). This issue was also highlighted by Leon, Schneider and Daviaud (2012) and Schweitzer and Synowiec (2012). These authors highlighted the need to expand the use of ICT for health care, using an approach that can absorb the cost burden associated with the use of ICT tools to encourage their use by the target groups. Schweitzer and Synowiec (2012) in their study on the economics of e-health and m-health stressed the need to come up with a public-private partnership model that can alleviate the costs of e-health at different levels of health delivery systems to encourage more investment in e-health and the use of ICT for health care. This will enable health workers and mothers to fully embrace the use of ICT for MCH care.

Valliere et.al (2012) in an e-health project in Sierra Leone identified other constraints such as poor network coverage and poor Internet connection. Because the network coverage of some of the telecommunication companies and Internet service providers is limited; disseminating health tips becomes difficult, especially for people in remote or rural areas of the country. This challenge was also highlighted by Mehl (2010) in his presentation in Geneva at the ITU conference on e-health projects in rural communities. A number of technical challenges have been linked to the poor network coverage in areas with irregular connectivity. This includes the loss of data as a result of faulty mobile devices, hardware loss, and the challenges of synchronising data with a personal computer or sending messages over a wireless network to a central server.

Apart from the problem with network coverage, the literature also shows that many of the ICT solutions are designed to work with Internet management systems and infrastructure that do not exist in many poor countries, especially in sub-Saharan Africa. Many countries in Africa (Nigeria inclusive) that do not have reliabl telecommunications coverage and the networks being deployed in these countries do not support the provision of Geographical Information system or other mobile broadband services. This has been a major a factor inhibiting the effective implementation of e-health project (Mechael et. al 2010; Leon et. al, 2012; Aranda-Jan, 2014).

In addition to these challenges, integrating a feedback mechanism into e-health project is another very important issue. This is to promote sustainability in the adoption of ICT in a manner that responds to user needs by involving them in the design process. Parmar (2009) identifies this in a study on e-health project in India. He discovered that ICT solutions based on constant feedback from users offered better economic opportunities and social inclusion of users, especially at the grass-roots level. A project tagged the Hole-in-the-Wall project in India which focused on children, involved users on a regular basis and also obtained feedbacks related to the children's attitude to learning about computers from stakeholders who were in a position to offer content that intrigued school children. This led to high acceptance of the project among school children. Two m-health interventions, the OpenMRS project in Kaduna and Every Child Counts project in Kenya have also highlighted the need for a feedback from target group. They emphasize the need for information flow to be in two directions, as this helps in evolving a sustained system with strong support from stakeholders (Berg, Wairiero, and Modi, 2009; Thompson, Castle, Lubeck and Makarfi, 2010). Clearly, the forgoing shows that there is sufficient literature to buttress the fact that e-health interventions for MCH must mainstream issues relating to ICT tool, language, content, cost, network coverage, power problem and feedback to achieve the desired objectives.

2.9   Theoretical framework

Researchers have posited that influencing the behavioural change necessary for the adoption of safe MCH practices by mothers requires a user-centred approach for the effective dissemination of health information (Parmar, 2009;Mechael, Betavia, Kaonga, Searle, Kwan, Goldberger, Fu and Ossman, 2010). To effectively disseminate information on MCH, it is important to evolve a user-centred approach based on a sound theoretical framework. Therefore, it is pertinent to revise and understand intention-based theories, in order to evolve a conceptual framework upon which the use of ICT by health workers for information dissemination in e-health programmes could influence the adoption of safe MCH practices by mothers. This will serve as a basis for health workers to understand and employ the appropriate information dissemination methods that will positively influence mothers' adoption of safe MCH practices.

In health care delivery, several theories had evolved to provide guidance for studies on the influence of use of ICT on health practices. However, for the purpose of this study, the Unified Theory of Acceptance and Use of Technology (UTAUT) provide the guide. The UTAUT framework evolved from a review of intention-based theories by Venkatesh et al in 2003. This study is predominantly anchored on this theory. The UTAUT is the outcome of the review and harmonisation of the constructs of eight models that previous researchers had used to explain information systems usage and behaviour. These theories are: The Theory of Reasoned Action, The Technology Acceptance Model, a Motivational model, the Theory of Planned Behaviour, a model combining the Technology Acceptance model and the Theory of Planned Behaviour, a model of PC Utilisation, Innovation Diffusion Theory and Social Cognitive Theory (Ajzen and Fishbein, 1980; Bandura, 1988;   Davis, 1989; Davis, Bagozzi, and Warshaw, 1989; Ajzen, 1991; Bagozzi, Davis, and Warshaw, 1992; Rogers, 2003).

The UTAUT model is frequently applied for studies on user acceptance of technology within the developing and developed countries. Kijsanayotin and Pannarunothai (2009) were among the first set of scholars to adapt UTAUT to predict the use of ICT for administrative purposes in Thailand. The results from the study indicated that intention to use e-health services is a function of the perception that e-health services are useful (perceived usefulness), that important others (family members and loved ones) believe they should use it (social influence), and that one has the choice to use ICT. All of these factors influenced behavioural intention to use e-health services with performance expectancy having the strongest effect. Nuq (2012) adapted the UTAUT to study e-health in 10 developing countries, with focus on ICT for clinical purposes. Nuq modified UTAUT and added new concepts such as medical education, government policy, and medical knowledge. These were derived from a pilot study he conducted. All of these influenced the adoption of e-health services in developing countries.

Tibenderana, Ikoja-Odongo and Wokadala, (2010), also modified UTAUT and developed a model which they tagged Service Oriented UTAUT (SOUTAUT). The SOUTAUT is a variant of the UTAUT. It extended the framework of UTAUT, to include awareness, relevance and expected benefits, but excludes effort expectancy and voluntariness of use. The scholars tested the validity of these concepts and then used the model to study end-users' acceptance and use of e-resources in a hybrid library. The study revealed relevance and social influence as determinants of intention to use or adopt new technology. This is in line with Kaba, N'Da and Mbarika, (2008), quoted in Tibenderana et al. (2010), where social influence was identified as a major determinant of ICT acceptance and use in an African setting (Uganda). This also confirms Miller's ((1976) and Venkatesh and Morris' (2000) submission that women find others' opinion and social influence significant when forming an opinion to use technology. Tibenderana et al. (2010) also noted that these results are contrary to what was obtained in similar studies in developed countries and

suggests cautious application of knowledge derived from acceptance and use of technology in developed countries to the developing ones.

In Nigeria, Oye, Iahad and Rahim (2011 ; 2012) adopted the SOUTAUT model in their study of the impact of ICT framework on academics' acceptance and use of ICT in two universities. These studies identified performance expectancy and effort expectancy as influential factors for the acceptance and use of ICT by academics. The studies further confirmed the validity of the UTAUT model in developing countries. Chiemeke and Evwiekpaefe (2011) implemented the model in a study on e-commerce in Nigeria. They modified the model and introduced the construct "Nigerian factor" as a determinant factor that could influence the adoption of e-commerce by Nigerians. The study was limited as it was based only on literature review; no empirical test was conducted by the scholars on the constructs of the proposed model.

As promising as the UTAUT model is, it has come under of criticism from scholars. For example, Bagozzi (2007) submits that the 41 independent variables for predicting intentions and eight independent variables for predicting behaviours present a chaotic scenario on the study of technology adoption. Similarly, Raaij and Schepers (2008) argue that moderating key relationships with four important variables was required to achieve a high $R^{2,}$ (coefficient of determination). This makes UTAUT more parsimonious than the previous Technology Acceptance Model. This criticism should be embraced from a positive stance because it enables the researcher to be more cautious, and to design strategies to sieve out the applicable variables that will be dependent on the target audiences, infrastructure, and other socio-economic and political factors.

The definition and proper understanding of the concepts of UTAUT is very important for envisioning this project. Performance expectancy, effort expectancy, social influence, facilitating conditions, and control factors are the five concepts that interact to operationalize the UTAUT framework. These concepts, with cues from literature and logical reasoning informed the

conceptual framework for this study. The concept of performance expectancy depicts mothers' perception of the relevance of MCH information received from an ICT source in improving their health condition. Effort expectancy refers to the degree of ease associated with the use of the system by health worker and mother's perception of ease of use of the ICT channel used for disseminating MCH information. The concept of social influence introduces the degree to which a health worker perceives that influencers expectation of the use of ICT and the degree to which mothers perceive that influencers (like their partner, family members and religious leaders) believe in the use of ICT disseminated information. Facilitating conditions considers the degree to which a health worker believes that organisational and technical infrastructure exists to support the use of ICT and the degree to which mothers and their partners believe that a structure exists to support the use of the system. This is measured by the perception of having the required resources or facilities, and knowledge to use the information from the ICT channel. The control factors take cognizance of gender, age, experience, education, voluntariness of use for the workers on one hand and the mother on the other hand. Incorporating external variables that influence the decision of patients is clearly illustrated by UTAUT. For this study it provides a framework for how the perceived usefulness of information disseminated to mothers could have profound influence on mothers' health information seeking behaviour, as influenced by the ease of use and convenience of the type of ICT tool. Considering it from mothers' perspective while integrating all these constructs in to the conceptual model will set the pace for this study.

In addition to the UTAUT, the Trans theoretical Model (TTM) propounded by Prochaska, Redding and Evers(2002) was used to identify the various stages of behavioural changes in order to determine the appropriate content and information dosage for each stage. Unlike other models of behavioural change that focus specifically on an aspect of change, TTM is an integrative, bio-psychological model that hypothesizes the process of planned behavioural change. The stages of

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change are pre-contemplation, contemplation, preparation, action and maintenance (see figure 2.1).
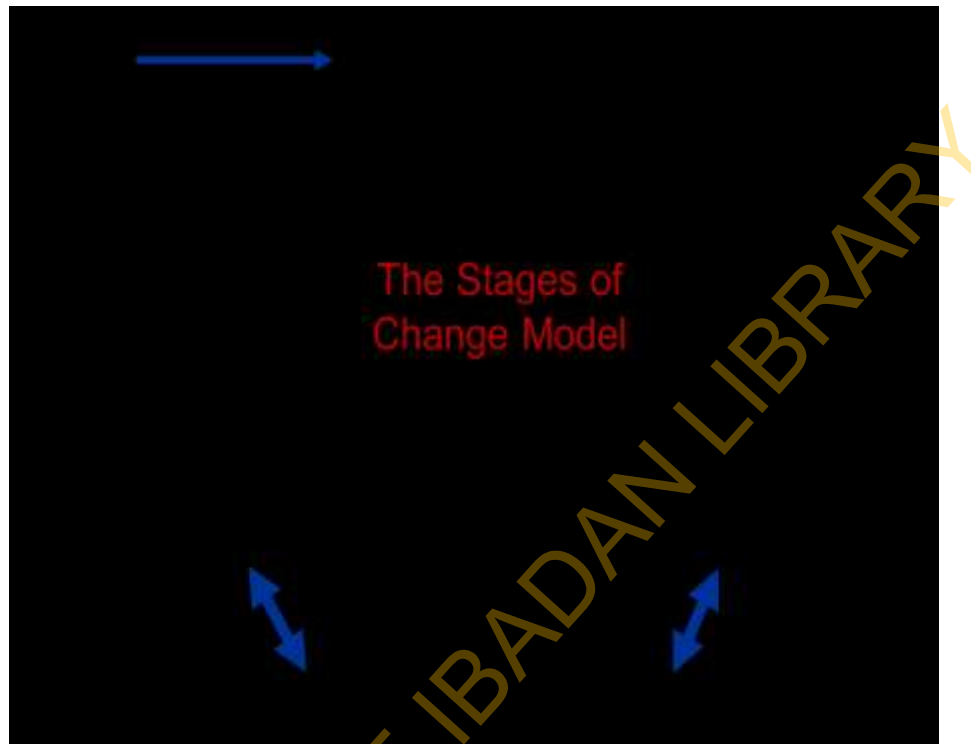
Figure 2.1: Trans theoretical Model (the various stages of behavioural changes)

Source: Behavioural Change Models (Boston University School of Public Health/Mobile Page)

Adams and White (2005) submit that the processes of change identified were subdivided into experimental and behavioural processes that reveal varying significance at different stages of transition. The experimental processes are consciousness raising, dramatic relief, environmental revaluation, self-re-evaluation and social liberation; while the behavioural processes are reinforcement management, helping relationships, counterconditioning, stimulus control and self-liberation. Self-efficacy related to the desired behavioural change, temptation and decisional balance have been found to further determine the successes of a healthy behavioural change process.

Therefore, to capture the various processes involved in realising healthy behavioural change, the Trans-Theoretical Model was used to augment the Unified Theory of Technology Acceptance and Use (UTAUT). This agrees with Armitage (2009), who avers that the processes of change in the TTM model could be the most useful part of the concept, and yet it is under-researched. This element of the model is promising for developing effective health behaviour - change interventions. However, extracting the constructs of the model may weaken its framework. But Littell and Girvin (2002), in a review of 87 studies on the stages of change, argues that the proposed stages in TTM are not mutually exclusive and that there is little evidence of movement in a successive manner through the stages in the model. Similarly, Bridle et al.(2005) claim that limited evidence exists in TTM that supports the effectiveness of stage-based interventions as a basis for behaviour change.

However, Johnson et.al (2008) and Levesque et. al (2008) have demonstrated that customized TTM-based interventions changes behaviours. Corroborating this view, Prochaska (2006), asserts that a lot of the studies that show the model to be ineffective, have interventions designed for the stage of change only. If the models used for these studies had included all the core constructs of the model, they might have shown positive findings.

The unacceptably high maternal mortality in Nigeria makes determining the influence of ICT use by health workers on mother's behaviour (adoption of safe MCH practices) important. The action stage in the TTM depicts the dependent variable, adoption of safe MCH practices by mothers. Therefore, from the arguments, TTM has the potential to generate the desired behaviour change; hence the information dissemination strategy must be structured to initiate immediate positive response. The change can be accelerated through a user-centred approach that will enable mothers, partners and influencers to access information through multiple ICT channels. This should cover all the constructs of the model, and all aspects of care recommended by WHO for mother and child, to allow enough time for behavioural change to occur. Therefore, aligning with

Johnson et. al (2008) and Levesque et. al (2008), an amalgam of UTAUT and TTM will yield a hybrid model that will effectively meet information needs along the continuum of care and, consequently, influence behavioural change.

2.10   Conceptual framework

The conceptual framework for this study was developed from cues from literature reviewed and logical reasoning. In general, health workers and information professionals compile and process information from research, medical records and practice/experience, and then package or repackage the information into languages, styles and formats that will influence mothers positively to internalise safe MCH practices. This is the information processing stage. The information processing, dissemination and awareness creation is targeted at the pre-contemplation, contemplation and preparatory stages where conventional media and mobile phones are used to inform and persuade mothers and their influencers about the risk they are exposed to if they do not seek proper care and take necessary precautions during conception, pregnancy and childbirth. It is important to target periods before conception to allow time for decision-making.

However, this would be an ongoing campaign during which information dissemination must be sustained or unhindered, as conception takes place on a daily basis. Further doses of information are disseminated and the mothers begin to seek more information as they take action to change unhealthy behaviour. This is referred to as the Action Stage.

Often times, the ICT type and channel, religion and belief, socio economic status, and personal characteristics have profound influence on behavioural change which leads to the adoption of safe MCH practices. During this stage, the mother decides in favour or against seeking proper care and adopting safe MCH practices (DiClemente andNorcross,; Prochaska,

Redding and Evers, 2002; Prochaska1992; Nelson, Kreps, Hesse, Croyle, Willis and Arora, 2004). One very important success strategy in these stages is to ensure sustained dissemination of information. The adoption of these models assumes that before information is disseminated, the team of health workers and information professionals would have studied the target audiences through a detailed survey and needs assessment to ensure that information disseminated is specially packaged or repackaged and tailored to meet their peculiar situation (Prochaska, 2006). This approach priotises the needs of the user (mothers), unlike the generic approach to information dissemination.

The conceptual framework for the study is presented in Fig 2.3. It is assumed that issues concerning personal characteristics, social influence and environmental factors would have been addressed by health professionals during the information processing and repackaging stage. Technology (ICT channels), content, language and style would be based on a user-centred approach.

Independent Variables

Mothers perceived health workers' (nurses, community health workers) ICT use

use of Mobile phones, TV and Radio, Internet and computer by health workers for information dissemination

Dependent Variable

Maternal and child health practices

1. Regular antenatal, postnatal visits
2. Child immunisation
3. Family planning
4. Breastfeeding

Mothers' perception of ICT-disseminated information relevance

Perceived usefulness of ICT and relevance MCH information received via ICT

Please note: *Issues concerning personal characteristics, social influence and facilitating conditions would have been addressed by information experts during the information processing and re-packaging stage.*

Figure 2.2: Conceptual Framework of the study developed from cues from literature and logical reasoning

The framework proposes a number of relationships and interactions between the variables under study. It proposes that mothers' perceived health worker ICT use will directly influence MCH practices of mothers. The model proposes also that mothers' perception of usefulness of ICT and relevance of disseminated information would influence their MCH practices.

The conceptual framework illustrates that mothers perceived health workers' ICT use and perceived relevance of ICT-disseminated MCH information can have a positive influence on mothers' MCH practices. Thereby, influencing their behaviour, and leading to the adoption of safe MCH practices. Essentially effective use of ICTs, disseminating the right information (specially packaged to suit the needs and personal characteristics of the target audiences) at the right time with acceptable ICT, all combine to yield the desired positive behavioral changes and safe MCH practices. Ultimately, safe MCH practices will translate into maternal and child mortality reduction (MCMR).

2.11 Appraisal of the literature reviewed

The literature reviewed has shown that the adoption of ICT for MCH in Nigeria is low, although ICT is generally used for disseminating information on MCH. Health workers in Nigeria use ICT for communication, decision support and knowledge transfer. The review identified the prevalence of application of mobile phone technology for MCH probably because of its ubiquitous nature and ease of use. It also documents challenges, lessons and outcomes of ICT-based (e-health) programmes for MCH in Nigeria. Results from the ICT-based programmes reviewed indicate that ICT could be used to reduce the high maternal, newborn and child mortalities in the country. It also shows that using ICT for information dissemination on MCH (health promotion) could change the wrong perceptions of stakeholders and possibly influence the target group to adopt healthy practices.

However, challenges of ICT use by health workers for MCH information dissemination identified include power problem, low IT skill, financial issues, language barrier, e-health implementation approach, distance, attrition of health workers and infrastructural constraints. Whereas barriers to the use of ICT in accessing MCH information mentioned by mothers include sharing of ICT tools, low literacy skill, attitude of mothers, presentation and format of disseminated information; while facilitators of ICT use for health workers and mothers include continuous encouragement, training, awareness, involving decision makers around women, strong political support and collaboration amongst stake holders.

Most studies on the use of ICT for MCH information dissemination have focussed on the influence of ICT use by health workers on health outcomes such as, skilled birth deliveries and number of referrals. Studies investigating the influence of the use of ICT by health workers, relevance of disseminated information as well as the influence on maternal and child health practices from mothers' perspective are uncommon. It is this research gap that the present study intends to bridge.

3.1   Introduction

This chapter focuses on the research method used for the study. It is treated under the following sub-headings:

3.2   Research design

3.3   Population of the study

3.4   Instruments for data collection

3.5   Sample size and sampling technique

3.6   Validity and reliability of instruments

3.7   Procedure for data collection

3.8   Ethical approval

3.9   Method of data analysis

3.2   Research design

The descriptive survey research design of the correlational type was adopted for the study. The descriptive survey of correlational type was adopted because the study sought to determine the type of linear relationship between mothers' perceived health worker ICT use, their perception of ICT- disseminated information relevance to maternal and child health practices in Nigeria. According to Onifade (2004), correlation studies are usually

carried out in order to study the relationship between measures of different variables obtained at the same time. As a descriptive study, its focus was on the use of ICT for disseminating information on MCH in Nigeria from the mothers' perspective. It also examined mothers' perception of disseminated information relevance, as well as the influence of the use of ICT by health workers for information dissemination on MCH practices.

3.3 Population of the study

Four ICT-based projects for maternal and child health were found in nine health facilities located in four states of the country at the time of the study. These projects were found in four geo-political zones of Nigeria, namely North-East (Gombe), North-West (Kaduna), South-East (Imo) and South-West (Ondo). The e-health projects identified were: The OpenMRS Project in Kaduna, Abiye Project in Ondo State, Society for Family Health project in Gombe State and mhealth services for maternal and child health in Imo state. The states were identified by contacting the management of federal health tertiary institutions in each zone as well as the state ministry of health in each state. All health facilities with on-going e-health project were included in the study. Health facilities included had similar health project focusing on maternal and child health.

The population of the study consisted of nine health workers who were directly involved in these ICT-based projects for MCH in the four states. This population of health workers was made up of medium-skilled (nurses) and low-skilled health workers (community health workers). In addition, all mothers in the identified health facilities who were involved in e-health projects in the identified health facilities in the four states were considered for the study.

The population of mothers is an heterogeneous mix of women with different educational, social, and cultural background. The population of registered mothers involved in the study was 1001 mothers who were involved in the e-health projects. The total population of respondents for

the study was 1010, which was made up of all mothers (1001) and health workers (9) who were directly involved in ICT-based projects for MCH care in the identified states. See Table 3.2 for more information on the population for the study.

Table 3.2: Distribution of health facilities, mothers and health workers involved in ICT-based projects for MCH

State	e-health projects	Local Govt. Area (LGA)	No. of health facilities	No. of Registered mothers involved in e-health projects	No. of health workers involved in e-health projects for MCH
Ondo	Abiye Project	Ifedore	4	454	4
Gombe	MNLH e-health project	Billiri	2	295	2
Kaduna	OpenMRS Project	Makarfi	2	98	2
Imo	mhealth services at Federal Medical Centre	Owerri Municipal	1	154	1
Total			9	1001	9

3.4 Sampling technique and sample size

A preliminary enquiry was conducted in the nine health facilities and the total enumeration technique was used to select all registered mothers and health workers directly involved in the on-going e-health projects in the identified health facilities. The health facilities were selected because had similar operational ICT-based projects. The respondents were included in the study because they were directly involved in e-health projects in the nine health facilities. The doctors (highly skilled) were not directly involved in the e-health projects; so, they were excluded from the study. All mothers (1001) and health workers (9) who were directly involved in the ICT-based projects at the nine health facilities were involved in the study.

3.5   Data collection instruments

The researcher used both qualitative and quantitative tools to collect data from the health workers and mothers involved in the e-health projects for maternal and child health (MCH) in the identified health facilities. The instruments used were interview guide, questionnaire and focus group discussion. A key informant interview guide was used to collect data from the health workers involved in the use of ICT for disseminating information on MCH in the identified health facilities. This was to determine the various uses of ICT for MCH care by health workers. The questionnaire and focus-group discussion (FGD) were also used to elicit information from the mothers. The data collection instruments used to elicit information from the respondents are described in details as follows:

3.5.1 Questionnaire for mothers/pregnant women

The instrument contained five sections (A, B, C, D and E). Section A had nine items which focused on the demographic details of respondents. Section B had six items (ICT Use), focusing on types of ICT and MCH information disseminated through the channel. Section C (Mothers'

perception of disseminated information) consisted of 10 questions on mothers' perception of ICT and health information disseminated. The scale for measuring mothers' perception of ICT-disseminated MCH information was developed based on cues from the UTAUT scale for measuring performance expectancy, that is, the gains or perceived usefulness from an information system (Davis, 1989; Venkatesh et. al., 2003).

Section D (MCH Practices) contained seven items focusing on the adoption of MCH practices by mothers. Section E focused on barriers to receiving MCH information and adopting healthy practices. The items that measured the influence of ICT use by health workers on MCH practices from the mothers' perspective were based on a two-point scale. Respondents were asked to indicate their agreement or disagreement with several statements, with 0= Disagree and 1=Agree (See Appendix I).

3.5.2 Focus group discussion schedule for mothers

Focus Group Discussion (FGD) sessions were also organised for the mothers to gather additional data for the study. According to Lindlof and Taylor (2002), FGD is useful in gathering data and insights that are less accessible without interaction with the object of interest in a study. It provides an opportunity for disclosure among study participants, to validate information or data gathered.

The researcher and the research assistants arranged focus group discussion sessions with mothers at the identified health facilities. The FGD schedule had nine main questions and there were 30 participants in all (10 in Ondo State, 8 in Imo State and 6 each in Kaduna and Gombe States), who took part in the four FGD sessions organised for the mothers. The respondents who participated in the FGD sessions were mothers who were directly involved in e-health projects in

the identified health facilities and who were also willing to participate in the focus group discussion sessions. The FGD sessions conducted with the thirty mothers was recorded on audio tapes. The audio recordings were transcribed and the transcripts were translated into the English Language. The results from the FGD sessions with the mother were subjected to thematic analysis using Nvivo -application software for qualitative data (Appendix II).

3.5.3 Key Informant Interview guide for health workers

Due to the small size of the health workers currently involved in the e-health projects; the researcher and the research assistants interviewed health workers in the identified health facilities who were involved in e-health projects for MCH using the semi-structured interview guide. This guide consisted of ten questions on the health workers' demographic details and eleven questions on the use of ICT for disseminating of MCH information. The questions focused on the use of ICT for disseminating MCH information by health workers, challenges/motivation for the use of ICT and trends in MCH practice of mothers that have evolved as a result of ICT use for MCH care. A total of nine health workers involved in the use of ICT in the health facilities were interviewed (Appendix III).

3.5.4 Validity and reliability of the instruments

To ascertain the validity of the instrument, it was given to the researcher's supervisor and other experts in the field of information science and psychology to review. Their comments and suggestions were used to improve the draft questionnaire. The questionnaire was also pretested at one of the health facilities that were excluded from the study in Ifedore Local Government Area of Ondo State. The instrument was administered to 25 pregnant women at the General Hospital Igbara Oke. Based on the findings from the pre-test, some questionnaire items were modified to make the instrument less cumbersome. The reliability coefficient for the sub-scales was calculated

using Cronbach Alpha. The value of 0.79 was obtained for ICT use, 0.86 for mothers' perception of disseminated information and 0.81 for MCH practices.

3.6   Data collection procedure

The researcher conducted a pretest of the instruments for the data collection. Lessons learnt from this test were transferred to the research assistants to improve data integrity.
The nine health facilities identified in the four states were contacted. This was carried out with a letter of introduction from the Head of Department of Library, Archival, and Information Studies (LARIS), University of Ibadan and my research supervisor. Participants for the study were contacted with the help of health workers monitoring the health of mothers involved in the ICT-based project.

The researcher engaged the services of seven research assistants (four for Ondo State, two for Kaduna and Gombe states and one for Imo State), who could speak the local languages in the four states, to administer the questionnaire. The data collection took nine months (February-September, 2015). The activities of the research assistants were monitored through phone calls, weekly reports sent via electronic mails and monitoring visits to the states by the researcher. With the assistance of research assistants, the researcher also conducted focus group discussion for mothers and interviews with the health workers to elicit data from them.

Nine health workers who were directly involved in ICT-based project at the identified health facilities were interviewed. In addition, four focus group discussions were organised for thirty mothers (ten from Ondo State, eight from Imo State and six each from Kaduna and Gombe States) involved in ICT-based projects from the four states, who were willing to participate in the focus group discussion sessions. The questionnaire was also administered on all the 1001 mothers directly involved in ICT-based projects identified in the four states (Ondo, Imo, Kaduna and Gombe States) in Nigeria.

3.7   Ethical considerations

Data collection for the study was initiated after an ethical approval of the research protocol was obtained from the University of Ibadan/University College Hospital Ethical Review Committee. The researcher ensured that participation by mothers and health workers was voluntary, and all information provided was treated confidentially. Informed consent was obtained from participants before they were enrolled for the study. Participants were allowed to withdraw if they were no longer willing to participate in the study.

3.8   Method of data analysis

Descriptive statistics, such as frequency counts, percentages, mean and standard deviation were used to analyse the research questions. The first and second hypotheses were tested using Pearson's Product Moment Correlation Coefficient. The third and fourth hypotheses were tested using Regression Analysis, all the hypotheses were tested at 0.05 level of significance

The qualitative data (conversations from interviews and discussions from FGDs) were transcribed and subjected to thematic analysis. Out of the 1001 copies of the questionnaire filled by the mothers, 931 were valid for statistical analysis, representing a response rate of 93%. While the quantitative data were analysed using SPSS (Statistical Package for Social Science), the qualitative data were content analysed using Nvivo (a software package for analyzing qualitative data). The transcribed data was loaded into Nvivo to identify themes that emerged during focus group discussion with the mothers and interviews with the health workers. The number of times themes such as type of ICT used , MCH information disseminated, relevance of MCH information disseminated emerged were scored and presented in the tabular form (See Tables 4.6 and 4.9). Appendix V gives more information on the data analysis plan.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1   Introduction

This chapter presents the findings of data collected, the interpretation as well as discussion of the results. The study investigated the use of ICT by health workers from the mothers' perspective, mothers' perception of ICT-disseminated information relevance as well as influence on maternal and child health (MCH) practices in Nigeria. The demographic characteristics of the respondents and research questions were analysed using descriptive statistics of frequency counts and percentages, mean and standard deviation.

Details of the findings are presented as follows:

4.2   Profile of health facilities and respondents

The health facilities for the study were from four states in Nigeria. In Ondo State, four basic health facilities were selected for the study. The health facilities were selected from the Ifedore Local Government Area (LGA) where the *Abiye* project was initiated. They are Basic Health Centre, Molete, Basic health Centre, Isarun, Basic Health Centre, Igbaraoke and Basic Health Centre, Iloro. In Gombe State, two basic health facilities were selected, the Wange Maternity Centre and Popandi Health Centre in Kaltungo. In Kaduna State, two health facilities with on-going e-health projects for MCH were selected; they are Primary Health Centre, Baganje

and Tudu Primary Health Centre in Zaria LGA. The only health facility in Imo State with an on-going e-health project, that is, the Federal Medical Centre Owerri was also included in the study. The health facilities were selected for the study because of the presence on-going e-health project for MCH in them. In all, a total of nine health facilities were studied (See Table 4.1).

Table 4.1 Profile of health facilities selected for the study

State	e-health projects	Local Govt. Area (LGA)	No. of health facilities
Ondo	Abiye Project	Ifedore	4
Gombe	MNLH e-health project	Billiri	2
Kaduna	OpenMRS Project	Makarfi	2
Imo	mhealth services at Federal Medical Centre	Owerri Municipal, LGA	1
Total			9

The respondents for the study consisted of 1001 mothers and nine health workers involved in on-going e-health projects for maternal and child health (MCH) identified in the four states, namely: Ondo, Imo, Kaduna and Gombe States. The population of mothers who participated in the study was an heterogeneous mixture of the literate, semi-literate and illiterate. The health workers who participated in the study were the medium-skilled (nurses) and low skilled (community health workers) health professionals. The two categories of respondents were enrolled for the study

because they were directly involved in projects involving the use of ICT for the delivery of MCH information in the states studied (Table 4.2).

Table 4.2: Distribution of the respondents by state

State	No. of registered mothers	Nurse	Community health worker
Ondo	454	3	1
Gombe	295	2	-
Kaduna	98	1	1
Imo	154	1	-
Total	1001	7	2

4.2.1 Demographic characteristics of the health workers

The health workers who participated in the study were all females in the age range of 28-55 years. The health workers were enrolled for the study because they were involved in the ICT-based projects at the identified health facilities. Eight of them were registered with the Nursing and Midwifery Council of Nigeria and only one of the respondents had a certificate in community health extension (Table 4.3).

Table 4.3: Distribution of the health workers by demographic characteristics

State	Health facility	Designation	Age	Gender	Education/Qualification
Ondo	Basic Health Centre Molete	Senior Nursing Officer	52	Female	Registered Nurse (RN)
	Basic Health Centre Isarun	Nursing Officer	45	Female	RN
	Basic Health Centre Igbaraoke	Health ranger (Community Health Worker)	65	Female	Certificate in Community Health Extension
	Basic Health Centre Iloro	Nursing officer	37	Female	RN
Gombe	Wange Maternity Centre	Nursing officer	35	Female	RN
	Popandi Health Centre	Nurse supervisor	51	Female	RN
Kaduna	Primary Health Centre Baganje	Nursing officer	55	Female	RN
	Tudu Primary Health Centre	Community Health Worker	28	Female	RN
Imo	Federal Medical Centre	Senior Nursing Officer	43	Female	RN

*Total: Nine health workers

4.2.2 Demographic characteristics of the mothers

The background data collected from the mothers revealed that majority of them 893(95.9%) were married and 38 (4.1%) of the respondents were single. About 66 (7.1%) of the respondents were within the age range of 41-45 years; 12(1.3%) were within 46-50 years; while only 1(0.1%) respondent was over 50 years.

A tabulation of the distribution of the mothers by state in Table 4.4 shows the proportion of mothers from each of the four states.

Table 4.4: Distribution of the mothers by state

State	Frequency	Percentage
Ondo	400	43.0
Gombe	285	30.6
Imo	148	15.9
Kaduna	98	10.5
Total	931	100.0

The survey showed that 450 (48.3%) of the respondents were Christians, 471 (50.5%) were Muslims, while only 10 (1.1%) belonged to other religions. As regards ethnic group, 400 (42.9%) of the respondents were Yoruba, 148 (15.9%) were Igbo, 302 (32.4%) were Hausa, while 81 (8.7%) belonged to other ethnic groups. The results indicated that 173(18.5%) of the respondents did not disclose their income and 321 (34.5%) of them earned less than N20000 per month ($100). Over thirty percent (316, 33.9%) were within the income level of N20000-N50000 per month

($100-254), 103(11.1%) were within the income level of N50000-100000 per month ($254- 502), while only two percent (19, 2.1%) of them earned over N100, 000 per month (>$502).

As at the time of the study, 557 (59.8%) of the respondents had obtained educational qualifications below the school certificate, while the remaining 374 (40.2%) obtained educational qualifications higher than the school certificate. In addition, 530 (56.9%) of the respondents resided in the urban areas, while 401 (43.1%) resided in the rural areas. Information on selected demographic details of the mothers is presented in Table 4.5.

Table 4.5: Distribution of the mothers by demographic characteristics

S/N	Demographic Variables	Frequency	Percentage (%)
1	Marital Status		
	Single	38	4.1
	Married	893	95.9
2	Religion		
	Christianity	450	48.4
	Islam	471	50.5
	Others	10	1.1
3	Education		
	< School Cert	557	56.9
	SSCE+	374	40.2
5	Income		
	< N20,000	321	34.5
	N20,001 - N50,000	316	33.9
	N50,001 - N100,000	103	11.1
	> N100,000	19	2.0
	No response	172	18.5
6	Age		
	< 20	48	5.2
	20-25	167	17.9
	26-30	279	30.0
	31-35	222	23.8
	36-40	136	14.6
	41-45	66	7.1
	46-50	12	1.3
	> 50	1	0.1

Mean Age ($\overline{X}$) = 30.2yrs   N= 931

4.3 Presentation of the research questions

The study provided answers to seven research questions. They are presented as follows with the findings.

4.3.1 Research Question 1: What types of ICT do health workers use for information dissemination on maternal and child health (MCH) in Nigeria?

To verify the data collected and to ensure a deeper understanding of the variables of interest in the study; data collected from the interviews with nine health workers, questionnaire administered on 1001 mothers and nine focus group discussions organised for 30 mothers were used in answering the research question.

The interviews conducted in the four states with nine health workers revealed the ICT channels used in disseminating MCH information to mothers. The ICT channels used as indicated by health workers were mobile phones, the Internet, television/, radio, projectors and public address system (Table 4.6). Health workers in the four states used the mobile phone for sending reminders on antenatal/postnatal visits and immunisation to mothers. The mobile phone was also used for referrals and consultations during emergencies. The use of the Internet for sending MCH information was only reported in Imo and Ondo States.

Table 4.6: ICTs used by health workers for disseminating information on MCH in Nigeria

S/N	ICT channels used	Ondo	Imo	Kaduna	Gombe	Total
1	Mobile Phone: Use of phones for sending reminders on antenatal/postnatal visits, immunisation, referrals and consultations in Emergencies.	√	√	√	√	4
2	Television: Use of television for interactive live programmes to support e-health projects at the health facility.	√	X	√	√	3
3	Television/DVD: Use of TV/DVD to disseminate health tips.	X	√	√	√	3
4	Radio: Use of radio for interactive live programmes to support e-health projects at the health facility	√	X	√	√	3
5	Public Address system: Use of public address system to disseminate MCH information in the community.	√	X	√	√	3
6	Internet: sending personal emails on safe MCH practices to mothers.	√	√	X	X	2
7	Projector/Laptop: Use of projector and laptops during health talks.	X	√	√	√	3

√ = Used, X= Not Used   N= 9

Source: Interview with health workers

Details of interview sessions with the health worker on the use of ICT for MCH information dissemination are hereby presented:

In Ondo State, a matron in one health facility in charge of the *Abiye* Project described how the mobile phone was used:

"We normally use the *Abiye* phone to remind pregnant women about their antenatal appointments and we watch over them till they give birth. We do this to discourage pregnant women from visiting *Iya Agbebi* (Traditional birth attendant)".

A health worker interviewed in Gombe State reported that: "We use projectors during antenatal clinics. We also pass information to women through text messages. It saves time and reduces pressure. It has reduced the crowd at the clinics daily".

Similarly, in Kaduna State, a health worker confirmed the use of phones:

"In this health facility, we have volunteers and community health workers monitoring pregnant women and mothers. They (volunteers and community health workers) monitor their health using mobile phones and we can call the women directly to find out about their health. The pregnant women and mothers also call us when they need help or during emergency. Most of the women who are registered with us usually contact us on phone, even at odd hours, and we listen to them".

In Imo State, the use of the mobile phone for MCH information dissemination was a little different. Besides its use for sending text messages and calling mothers, a health worker also indicated that: "Sometimes, I make audio recordings of health talks which I transfer to their (mothers') phones through Bluetooth or file sharing application or the Internet, especially those with android phones".

Apart from the reported applications of mobile phones described, the health worker described specific application of other ICT tools. These comments described how the other ICT tools were used in the selected states. In Imo State, the health worker stated that: "Apart from face to face

chat; we have DVD containing video recordings on the care of mother and child during pregnancy. So we play the DVD for mothers to watch during antenatal clinics. We do this while taking the vital signs of the mothers".

One health worker in Kaduna State stated that:

"Like I told you we use power-point slides and projector for our presentation. My specific role is to prepare the information on slides. We normally use this during antenatal and postnatal visits".

Some of the health workers, especially those involved in the *Abiye* project in Ondo State also indicated the use of other applications of ICT tools. In Ondo State health workers reported that they use other ICT devices, like IPad and laptops for generating monthly reports, which they normally send to the State Ministry of Health by email. The monthly report often contained statistics and other information indicating the total number of antenatal visits, postnatal visits, child immunisations and deaths. They no longer travel down to the state capital to submit the report. The use of the Internet by health workers for MCH information was also reported in Imo State. The health worker in Imo State reported using it for referrals during emergencies, preparing power points slide for health talks and sharing of MCH information with mothers.

Regarding the use of radio for MCH information dissemination, the health workers reported its use to support on-going e-health projects for MCH in the health facilities. A major programme mentioned by one health worker was the "Mother and Child programme" on Radio Nigeria. This programme was usually anchored by health workers from the state ministry of health. They are designed to support on-going e-health projects in the states.

In order to highlight the valuable comments made by some of the health workers, data collected from the questionnaire administered on the mothers were used to authenticate those collected from health workers. The questionnaire administered on the mothers indicated that health workers (708, 76%) used the mobile phone more than other ICT channels for disseminating information on safe MCH practices. This was followed by radio 623 (66.9%) and the least used

ICT was the Internet/computer 22(2.4%). The health workers and mothers reported that mobile phones were commonly used in the four states (Table 4.6 and 4.7). This was followed by the radio. The two categories of respondents also confirm the low usage of the Internet/Computers and other ICT channels like public address system and projectors.

Table 4.7: ICT use by health workers for MCH information dissemination as reported by the mothers

ICT	Freq.	%	Ranking
Mobile phones	708	76.0%	1
Radio	623	66.9%	2
Digital video/Television	513	55.1%	3
Others (laptop/projectors)	254	27.3%	4
Internet/computer	22	2.4%	5

N=931

The breakdown of the types of ICT used by health workers for MCH information dissemination by state as revealed by the questionnaire administered on the mothers is presented in Figure 4.1. The result showed that mobile phone was a popular ICT in the four states selected for the study. The figure indicates that while the use of mobile phone for MCH information dissemination was widespread in the four states, the use of the Internet/computer was the lowest across the four states.

In summary, responses from health workers and mothers indicated that mobile phones were commonly used in the four states. This was followed by the radio. The two categories of respondent also confirm the low usage of the Internet/Computers and other ICT channels like public address system and projectors.
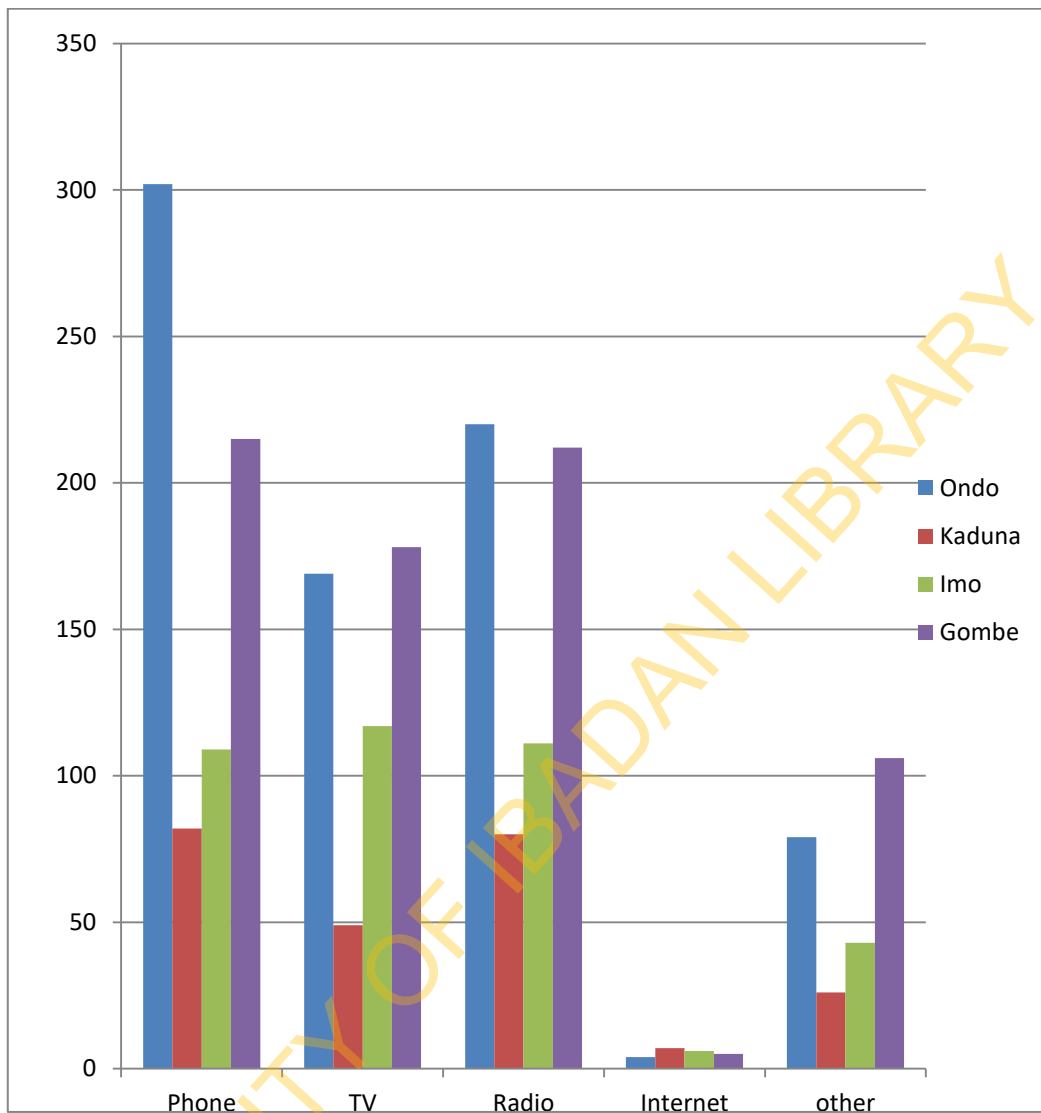
Figure 4.1: Types of ICT used by health workers for information dissemination on MCH by the state

As presented in Figure 4.1, health workers used mobile phones, television, radio, public address, projector/laptop and the Internet for MCH information dissemination. This was further verified with the information obtained from focus group discussion organised for the mothers in the four states. The findings in the Figure 4.1 not only highlight the popularity of mobile phone for MCH information dissemination in the four states. It also indicates that mothers in Gombe and Ondo States also use other ICT channels like television and radio frequently, when accessing MCH information. Most mothers in these states confirmed the use of phones by health workers.

In Ondo State, a nursing mother involved in the *Abiye* Project described the use of phone thus: "We were given phone, drugs and delivery kit when we registered so that we can call the clinic when we need to talk to Mama (matron) or the health ranger (community health workers) about our health. The health ranger and Mama (matron) also call to give us information or to find out about our health".

Likewise, in Gombe State, a pregnant woman stated that; "My first impression when we were given the phone was good. Many of us could not operate the phone but we were taught how to use it. I use it to call the nurse at the health centre. The nurses can call or sometimes send information to us to come for check-up".

A woman in Imo State also commented that: "With the phone we can now access information on how to take care of ourselves during pregnancy, even when we cannot get to the hospital".

In Kaduna State, a nursing mother volunteered the following information: "I usually make phone calls to the nurse at the health facility to find out when the next injection for my baby will be available; this is because the vaccines are not always available at the health facility".

Furthermore, information from the FGD sessions with the mothers affirmed the use of the radio and television for MCH information dissemination. A mother, during the FGD in Ondo State confirmed that she also received MCH information disseminated using radio despite the use

of phones for MCH information dissemination: "I receive more information from the radio. I am a trader and I always put on my small radio when I'm in the shop. I always listen to the radio programme "Mother and Child". I like the programme".

Another mother in Gombe State also asserted that: "I still use the television and radio a lot because I get more information and pictures. The information the matron gives during the clinic is not sufficient. When I call the nurse at the maternity centre we only talk for a short time because of airtime and sometimes nobody picks your call".

To determine how often mothers received MCH information from ICT channels, responses from the mothers were sought through questionnaire and focus group discussions. In the questionnaire, mothers were asked to indicate the frequency of use of ICT for receiving MCH information. Table 4.8 shows that a total of 439(47.2%, $\overline{X}$ =4.02) mothers received MCH information daily from the radio. Over a quarter received MCH information daily from mobile phones ($\overline{X}$ =3.54) and only 0.4% ($\overline{X}$ =1.08) could not remember the number of times they receive MCH information from ICT channels. The mean scores of their responses are shown in Table 4.8.

Table 4.8: Frequency at which mothers received MCH information disseminated using ICT

ICT used for receiving MCH information	Daily		Twice a week		Once a week		Once a month		Never		$\overline{X}$	SD	Var.
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
Mobile phones	248	26.6	312	33.5	184	19.8	70	7.5	117	12.6	3.54	1.299	1.687
Internet/ computer	35	3.8	138	14.8	74	7.9	159	17.1	525	56.4	1.92	1.253	1.571
TV	191	20.5	305	32.8	160	17.2	163	17.5	112	12.0	3.32	1.305	1.703
Radio	439	47.2	29	31.8	69	7.4	34	3.7	93	10	4.02	1.262	1.592
Others (public address system)	4	0.4	7	0.8	4	0.4	28	3.0	888	95.4	1.08	.422	0.178

N =931

Findings from the FGD sessions with the mothers on the frequency of use of ICT for receiving MCH information were slightly different. The FGD participants (mothers) reported using ICT frequently. A mother stated that:

"I use electronic devices every time at home, in office and everywhere. They are very useful".

Another said: "I use my phone "on the go" (every time) to access MCH information from the Internet. Apart from using it to access MCH information, I also use my phone for business".

This implies the use of ICT every time.

4.3.2 Research Question 2: What type of MCH information was disseminated to mothers by Nigerian health workers using ICT?

The interview with the health workers revealed the different types of MCH information disseminated to mothers. Health workers in the four states sent appointment reminders, health tip during emergencies, information on family planning, how to treat cold, catarrh, diarrhea, and nutrition in pregnancy (See Table 4.9).

Table 4.9: Types of MCH Information Health Workers Disseminate to Mothers Using ICTs

S/N	Type of MCH information	Ondo	Imo	Kaduna	Gombe	Total
1	Appointment reminders on antenatal/postnatal visits, immunisation	√	√	√	√	4
2	Health tips on what to do during emergencies	√	√	√	√	4
3	How to treat common cold and catarrh	√		√	√	4
4	How to treat diarrhea in children and during pregnancy.	√	√	√	√	4
4	Nutrition in pregnancy	X	√	√	√	3
5	Family planning	√	√	√	√	4

√ = Used, X= Not Used   N= 9

Data collected from the questionnaire administered on mother and focus group discussions organised for mothers was also used to verify this finding.

The researcher asked (through questionnaire) from the mothers the different types of MCH information being disseminated to them by health workers using ICT. The result presented in Table 4.10 shows appointment reminders (45%) as the most common type of MCH information

Nigerian health workers disseminate to mothers using ICT. This was followed by emotional changes in pregnancy (39.5%), family planning methods (34%), nutrition in pregnancy (32.8%), medication in pregnancy (30.6%), disease prevention in pregnancy (9.2%), breastfeeding (26%) and by other types (2.1%) of MCH information such as referral and consultations during labour. The health workers and mothers confirm the dissemination of MCH information like appointment reminders, family planning and nutrition in pregnancy.

Table 4.10: Types of MCH information mothers received from health workers using ICT

Type of MCH information	Yes		NO		
	Freq	%	Freq	%	Ranking
Appointment reminders	419	45.0	512	55.0	1
Mental health and Emotional changes in pregnancy	368	39.5	563	60.5	2
Family planning methods	317	34.0	614	66.0	3
Nutrition during pregnancy	305	32.8	626	67.2	4
Medication in pregnancy	285	30.6	646	69.4	5
Disease prevention in pregnant	272	9.2	659	70.8	6
Breast feeding	242	26.0	689	74.0	7
Others (referrals and consultation during labour)	20	2.1	911	97.9	8

N = 931

100

During FGD sessions, mothers indicated that they received information mainly about the unborn baby and existing children. Comments by some of them on the type of MCH received are given below:

"I receive information on pregnancy and child care from the health facility I'm registered with through phone calls. Sometimes, I listen to radio or television programmes (Gombe State)".

"….. and I get health information on how to care for myself, the unborn and existing children most of the time from television programmes (Kaduna State)".

"I get all the information I need from the internet I use the internet every day and I enjoy keeping up with tips concerning pregnancy and child care. I use this source for information that suits my immediate condition such as, why do I see droplets of blood? How can I remain healthy? How will I care for my unborn child? And sometimes, I try to find out how to determine the sex of my baby (Imo State)".

The responses of the mothers on the type of MCH information they received by state is also presented in Figure 4.2. The Figure presents details on the type of MCH information disseminated in each state.
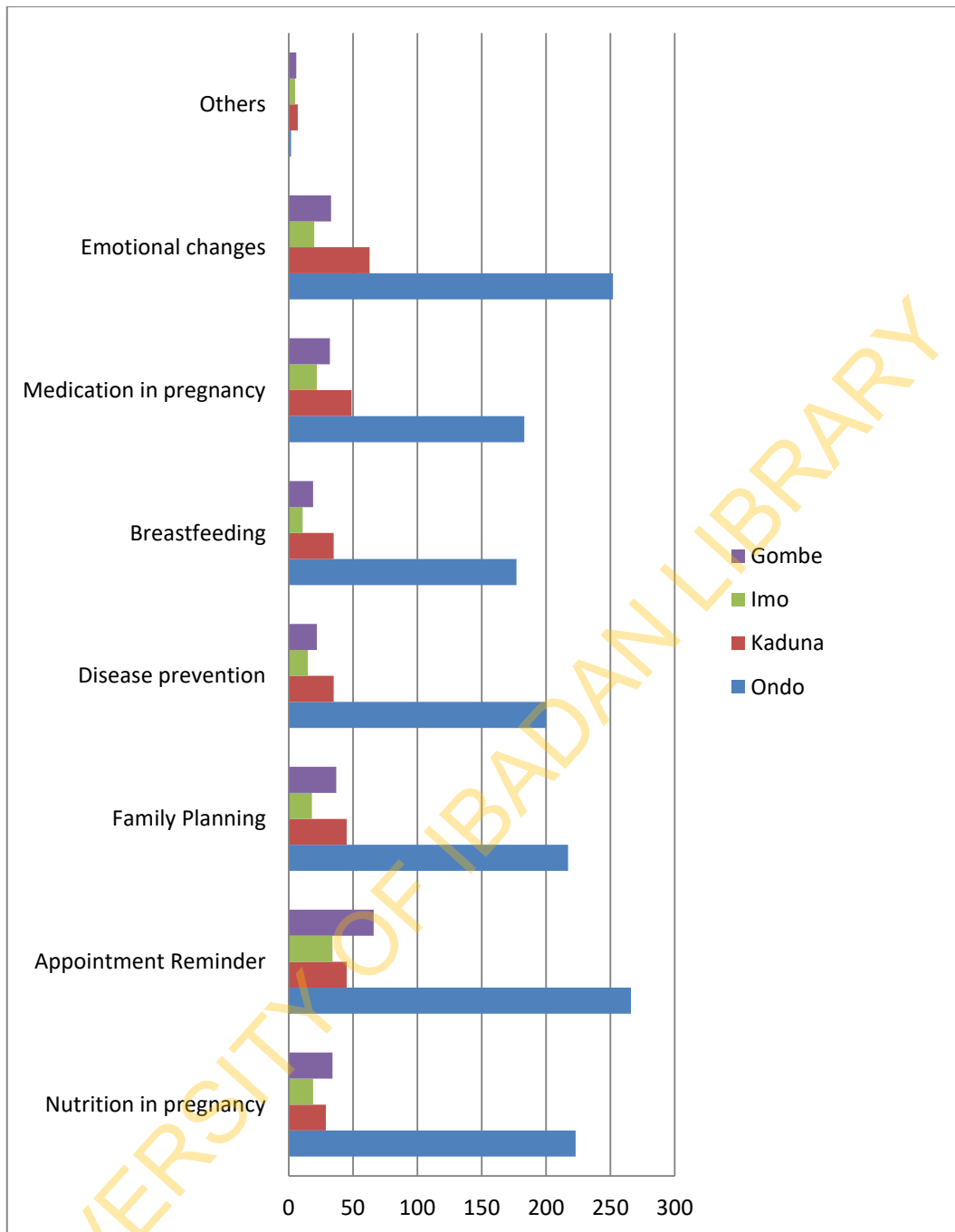
Figure 4.2: Types of MCH information mothers received from health workers using ICT

The study revealed the different formats of MCH information mothers received and the order of preference of the different formats for receiving MCH information. The questionnaire revealed the different format of MCH information received by the mothers. Tables 4.11 and Figure 4.3 show the different formats of MCH information received and the most preferred format respectively.

A breakdown by state of the different formats used by health workers when disseminating MCH information is presented in Table 4.11. The table revealed that a significant proportion of the mothers (642) in the four states received MCH information in the voice format.

Table 4.11: Format of MCH information disseminated to mothers by state

Format of MCH information	Ondo	Kaduna	Owerri	Gombe	Total
Voice	283	69	122	168	642(68.9%)
Picture	80	60	91	199	430(46.2%)
Text	4	3	5	1	13(1.3%)
Others (Songs and video etc.)	154	11	47	59	271(29.1%)

N= 931

103
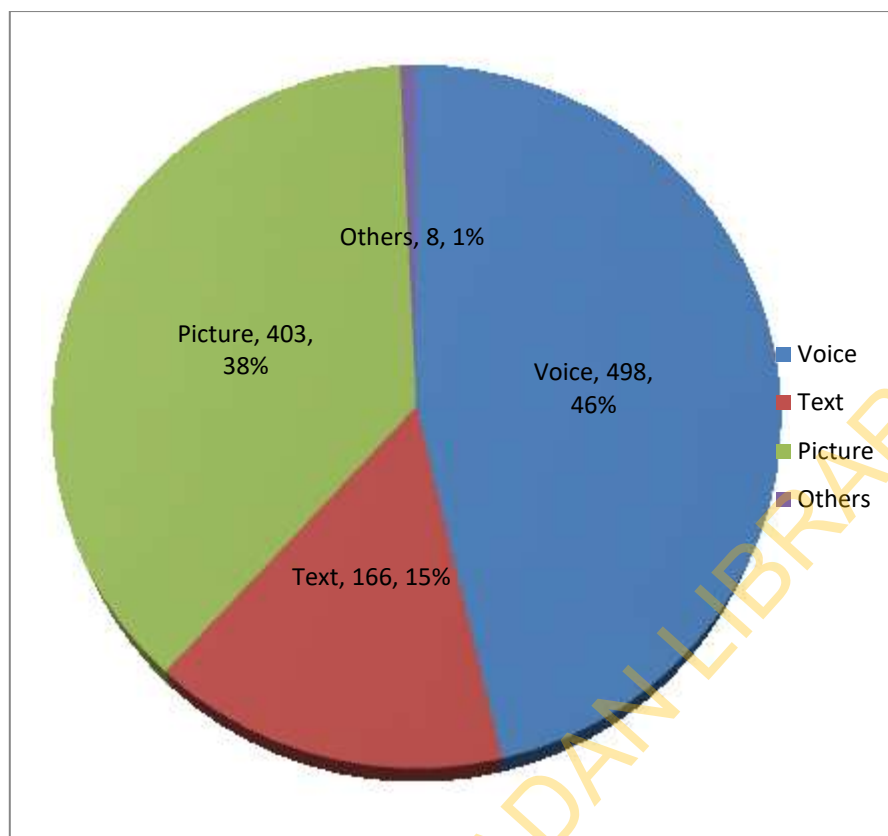
Figure 4.3: The most preferred format of MCH information mothers received

Although Figure 4.3 indicates voice as the most preferred by the mothers, result from the FGD data did not align with this finding. With the exception of Ondo State, the mothers during the FGD indicated preference for the other formats, especially the video or a combination of text and pictures. Below are some of their responses:

From a respondent in Imo State: "I prefer text and pictures or video. They are more explanatory, because they come with illustrations".

From another respondent in Kaduna State: "I like text and picture, because when I get information on exercises, I have to see exactly how it is done".

Also from Gombe State: "The video is my best format. I find it easy to understand the messages being transmitted. This is unlike the text messages which are sometimes not clear".

Only in Ondo State did respondents indicate a strong preference for voice format. A pregnant woman during the FGD in the state stated that: "I prefer voice format, once I call the matron, I always get immediate answers to pressing concerns about my health. This has helped me to stay healthy. This helped in saving my life and that of my unborn child at the early state of the pregnancy when I was bleeding".

4.3.3 Research Question 3: What are mothers' perceptions of the usefulness of ICT and relevance of MCH information disseminated using ICT?

In order to determine whether mothers' perception of disseminated information relevance was positive or negative, the researcher sought from the mothers their views about the usefulness of ICT and relevance of MCH information disseminated using the questionnaire and FGD. The result presented in Table 4.12 indicates that while the perception of the mothers on the usefulness of mobile phones and radio was positive, that of the Computer/Internet was negative. As revealed by the mean scores in Table 4.12, mothers indicated that phone (mean = 1.81, SD=0.78) was the most useful of all ICT channels for disseminating MCH information followed by radio (mean = 1.50, SD= 0.63). The result indicates that mothers' perception of mobile phones and radio was positive, but they expressed a negative perception towards the use of DVD/TV and Internet/Computer.

Table 4.12: Mothers' perception of the usefulness of ICT for communicating MCH information

Perception of the usefulness of ICT for receiving MCH information	Very useful		Useful		Not useful		$\overline{X}$	
	Freq	%	Freq	%	Freq	%		S D
Phone	393	42.2	326	35.0	212	22.8	1.81	0.78
Radio	536	57.6	324	34.8	71 7.6	7.6	1.50	0.63
DVD/TV	57	6.1	255	27.4	619	66.5	1.40	0.60
Computer/Internet	29	3.1	271	29.1	631	67.8	1.35	0.54

N= 931   Useful/Very Useful = positive, Not Useful = Negative

The responses of the mothers on the perceived usefulness of ICT by state indicate that mothers had positive perception of mobile phone and radio across the four states. The breakdown by state of the perceived usefulness of ICT channels is also presented in Table 4.13

Table 4.13: Mothers' perceived usefulness of ICT by State

Perceived usefulness of ICT	Responses	Ondo	Kaduna	Imo	Gombe	Total
Radio	Not useful	55	8	5	3	71
	Useful	124	57	51	92	324
	Very useful	221	333	92	190	536
DVD/TV	Not useful	219	62	88	250	619
	Useful	139	32	55	29	255
	Very useful	42	4	5	6	57
Internet/Computer	Not useful	226	58	135	212	631
	Useful	152	12	34	71	271
	Very useful	22	4	1	2	29
Phone	Not useful	101	41	20	50	212
	Useful	178	41	34	73	326
	Very useful	121	16	94	162	393

N = 931

Results from the FGD sessions with the mothers indicate that some of the mothers, especially those in Imo State indicated a positive perception for the Internet, a significant proportion (those in Ondo, Gombe and Kaduna States) also indicated a positive perception for mobile phones because of its relevance in meeting specific health information needs (especially during emergencies).

For example, one of the FGD participants from Imo State highlights the usefulness of the Internet: "I actually get more information from the Internet. If I am not satisfied with the information from the television or radio, I check different websites until I'm satisfied. This is not possible with the television or radio. This is why I prefer the Internet".

The mothers stressed the importance of the Internet as a robust source of MCH information as well as the opportunity it provides for them to access health information at their convenience, an advantage not available with other ICT channels. But they mentioned that the cost of Internet access and unstable Internet services prevented them from using the platform most of the time.

As regards the perceived relevance of MCH information, the mothers noted that the use of ICT- disseminated MCH information improved their knowledge about health issues surrounding pregnancy and childbirth (mean = 3.62, SD=0.60). Many of them indicated that the use of ICT-disseminated MCH information helped them to stay healthy in pregnancy (mean = 3.56, SD=0.68), and has improved their MCH practices (Mean = 3.51, SD=0.64). In addition, they indicated that ICT-disseminated MCH information helped them to manage common health conditions in newborns and children (mean = 3.48, SD= 0.67). The result indicates that mothers' perception of MCH information disseminated through ICT channels was positive. Table 4.14 presents the percentage, mean and standard deviation of Nigerian mothers' perception on MCH information disseminated using ICT.

Table 4.14: Nigerian mother's perception of MCH information disseminated using ICT

Mother's perception of the usefulness of MCH information from ICT channel	Agree		Disagree		$\overline{X}$	
	Freq	%	Freq	%		S D
ICT disseminated MCH information has improved my knowledge about health issues surrounding pregnancy and child birth.	906	97 .3	25	2.7	3.62	0.60
Over all use of ICT- disseminated MCH information has helped me to stay healthy in pregnancy.	881	94.6	50	5.4	3.56	0.68
ICT- disseminated health information has improved my MCH practices (Breast feeding habit, family planning methods, ANC visits, immunisation etc.)	894	96	37	3.9	3.51	0.64
ICT-disseminated health information has improved my use of health facilities.	89	95.9	38	4.0	3.51	0.64
ICT-disseminated health information has helped me to manage common health conditions in newborns and children.	882	94.8	49	5.3	3.48	0.67
ICT- disseminated health information has improved my health-seeking behaviour (knowing what to do and where to get help when in need of health care).	887	95.3	44	4.7	3.47	0.65
ICT- disseminated health information has improved decision making about my health.	893	95.9	38	4.0	3.46	0.64
ICT- disseminated health information has helped me to manage common health conditions (cold, malaria, and diarrhea) observed in pregnancy.	87	93.8	58	6.2	3.46	0.67

The findings in Table 4.14 indicate that mothers' perceived relevance of MCH information was positive. This was also confirmed by the mothers during the FGD sessions. According to some of the mothers, MCH information received from ICT channels were usually adequate, meeting most of their MCH information needs. The respondents' disposition to MCH information received from ICT channels revealed that they enjoyed keeping up with health tips concerning pregnancy and child care from these tools. They were of the opinion that they were more informed about issues relating to their well-being because of the use of ICT for disseminating information on MCH.

Some of the respondents were of the view that with the exception of interactive radio or television programmes that incorporate feedbacks from SMS or phone calls, MCH information from some of the ICT sources was usually limited. This was because it lacked feedback from target groups. In addition, the respondents (mothers) opined that television and radio programmes were usually short because of limited time frame as a result of expensive airtime. So, sometimes, the information provided may not be sufficient. They were also of the view that presenting MCH information in different local languages and levels was better. They believed that this should improve respondents' understanding of the messages being disseminated.

One of the mothers in Gombe State affirmed thus:

"When I make phone calls or watch TV programmes, the health information I get is usually limited. They are usually in a hurry because of call credit or airtime. It will be better to have more interactive TV or radio programmes in different dialects. This will provide us (pregnant women) more opportunities to clarify issues about our health".

Another mother in Imo State stated that: "The information I get from the television most of the time is usually in English. How I wish they (health workers) could make the information available in other local languages. They should provide information in Ijaw or Urhobo".

The FGD participants also stated that the content of messages from ICT channels (such as television, radio and phones) were not detailed or adequate enough when compared with MCH information they access from the Internet. Some mothers indicated that some health issues were not adequately covered by health workers when communicating MCH information using ICT. The issues include dieting and weight control (during pregnancy), types of medication to take during pregnancy, how to calculate expected delivery date, postpartum depression, and how to respond to complications such as vomiting and swollen legs in pregnancy.

4.3.4 Research Question 4: What is the effect of the use of ICT for disseminating information by health workers on MCH practices of Nigerian mothers?

To determine the effect of the use of ICT by health workers on MCH practices of Nigerian mothers, the health workers' and mothers' views were sought using interview, questionnaire and FGD. A major effect identified by health worker was the effect of the use of ICT for MCH information dissemination on antenatal and postnatal visits. Health workers reported an increase in the utilisation of health facility as a result of the use of ICT for MCH information dissemination. In Gombe State, a health worker highlighted this:

"We had a very good outcome just as I have stated that there was a great improvement in the turnout of pregnant women. Before, only 10 or at most 20 pregnant women visited the clinic; but

now we record 60 women coming for antenatal service in a day. They are becoming more aware of the health information and services we are providing".

Similarly, in Ondo State a matron stated that: "Our workload has increased; more women are coming to the clinic because of the *Abiye* programme. So we have more work to do".

However, the response from the health worker in Kaduna State indicated a different outcome. A comment from the health worker revealed that the use of ICT for communicating MCH information can also encourage low utilisation of health facilities. For example, the health worker in Kaduna reported that:

"Because most of the time we pass information to pregnant women through text messages, it saves time and pressure. It has actually reduced the crowd we attend to daily, while we still maintain good number of registered pregnant women. ICT has also made our follow-up for nursing mothers effective, especially for the immunisation of their infants".

As regards the effect of the use of ICT for communicating MCH information, a health worker in Gombe State reported an increase in mothers' awareness of MCH information and services. She stated that: "But now, we record 60 women coming for antenatal service in a day. They are becoming more aware of the health information and services we are providing".

In Ondo State, another health worker stated that: "The major outcome I can see is that several women can now access health information and services easily, even when they cannot get to the hospital".

Another effect observed, as reported by a health worker in Ondo State was the effect on infant death rate. The use of ICT by health workers led to a reduction in the occurrence of *Makije* (the deaths of newborns within the first week after birth) which is a major health challenge in Ifedore Local Government Area. This was how one of the health rangers in Ondo States put it:

"We normally experience *Makije* (the deaths of newborns within the first week after birth) in this area, but we observed that after the *Abiye* programme (Safe Motherhood e-health project) was launched by the governor, the death of newborns within the first seven days of life has reduced".

Apart from the effects on facility utilisation, access to MCH information and mortality, the health workers also reported the impact of the use of ICT for MCH information dissemination on their daily schedule and the attitude of health workers.

A matron in Imo State noted that:

"We have experienced great changes. The use of ICT changed the attitude of our staff and has made the job easier; everyone wants to be involved in the project".

A health worker in Ondo State argued that: "Our workload has increased; more women are coming to the clinic because of the *Abiye* programme. So we have more work to do".

The mothers' view about the influence of the use of ICT on their MCH practices was also sought. The mothers reported that the use of ICT for MCH information has influenced their MCH practices. This was indicated in their responses to the following statements: the use of ICT by health workers for appointment reminder helped me in completing the routine child immunisation for my baby ($\overline{X}$ =3.55, SD= 0.67); the use of ICT by health workers for information dissemination has helped improve my MCH practices (feeding habit during pregnancy, breastfeeding, family planning methods and immunisation) ($\overline{X}$ = 3.48, 0.69) ; and also improved my attendance at antenatal and postnatal clinic ($\overline{X}$ =3.42, SD=0.39).

On the other hand, some mothers indicated that the use of ICT for MCH information dissemination did not reduce the time spent seeking antenatal and postnatal services ($\overline{X}$ =3.39, SD=0.89, $\overline{X}$ =3.21, SD=0.91). Table 4.15 shows the percentages, mean scores and standard deviation for the effect of the use of ICT for MCH information dissemination on MCH practices of the mothers studied.

Table 4.15: The effect of the Use of ICT by health workers for MCH information dissemination on MCH practices as expressed by the mothers

Responses of mothers on the effect of the use of ICT for MCH information dissemination on MCH Practices	Agree Freq	%	Disagree Freq	%	Mean	SD
Use of ICT by health workers for appointment reminder has helped me in completing the routine child immunisation for my baby	882	94.7	49	5.3	3.55	0.67
Use of ICT by health workers for MCH information dissemination has helped to improve my MCH practices (feeding habit during pregnancy, breast feeding, family planning etc).	880	94.5	51	5.5	3.48	0.69
Use of ICT by health workers for MCH information dissemination has helped me identify where and when to seek medical help	875	94.0	56	6.1	3.46	0.68
Use of ICT by health workers for appointment reminders has made it possible for me to complete the expected number of attendance at antenatal and postnatal clinics.	873	93.8	58	6.2	3.42	0.39
Use of ICT by health workers has reduced time spent seeking antenatal services.	71	7.6	818	87.9	3.39	0.89
Use of ICT has reduced the time spent on seeking postnatal services.	113	12.1	788	84.6	3.21	0.91

N =931

This result was also verified with the data collected from the FGD sessions with the mothers. The response of mothers in Table 4.15 corroborates the report of the participants (mothers) involved in the FGD. For example, a nursing mother in Kaduna State stated that: "I usually make phone calls to the nurse at the health facility to find out when the next injection for my baby will be available; this is because the vaccines are not always available at the health facility. But with the phone I can find out when the vaccine will be available. This has enabled me to visit the hospital habitually for my child's immunisation".

In Ondo State, a pregnant woman stated that: "I prefer voice format, once I call the matron I always get immediate answers to pressing concerns about my health. This has helped me to stay healthy. This helped in saving my life and that of my unborn child at the early stages of the pregnancy when I was bleeding".

Another mother in Gombe state also observed that:

"Before now, women were not allowed to visit the hospital by themselves. We now understand why we should use health facilities; more people now have a change of attitude towards the use of health centre. More women now visit the maternity centre".

In Imo State, the view of some of the participants did not align with this finding. Some of the pregnant women during the FGD in Imo State indicated a contrary view. One of the views expressed is presented below:

"With the use of Internet and television health programmes, I don't usually attend antenatal. This is because I get all the information I need without moving an inch. I really don't like to go for clinics; I end up spending the whole day there".

The mothers also expressed their views on how the use of ICT has influenced specific MCH practices such as nutrition in pregnancy, antenatal/postnatal visits, child immunisation and

breastfeeding. The result in Table 4.16 presents mothers' views on the influence of the use of ICT on specific MCH practices. The mean scores of each item on Table 4.16 reveals that ICT was most influential on the family planning methods of the sampled mothers ($\overline{X}$ = 2.12), see Table 4.16. Breastfeeding habit was the least influenced by ICT.

Table 4.16: Reported influence of the use of ICT by health workers for information dissemination on specific MCH practices of the mothers

MCH Practices	Very Influential		Influential		Not Influential		Mean	SD
	Freq	%	Freq	%	Freq	%		
Antenatal/Postnatal visits	238	25.6	449	48.2	244	26.2	2.08	0.755
Nutrition in pregnancy	228	24.5	449	48.2	254	13.6	2.09	0.743
Child immunisation	261	28	427	45.9	243	26.1	2.08	0.765
Family planning	199	21.4	505	54.2	227	24.4	2.12	0.701
Breast feeding	242	26	338	36.3	351	37.7	1.98	0.820

N=931

4.3.5. Research Question 5: What are the MCH practices mothers adopt after receiving MCH information from health workers through ICT?

Using the questionnaire and FGD, the mothers were asked the type of MCH practices they adopted after receiving MCH information received from ICT channels. Table 4.17 indicates the

type of MCH information mothers adopted after receiving MCH information. While a significant proportion of the mothers (83%) adopted the safe MCH practices recommended by WHO (2007), 7.7 % adopted the traditional practices (visited traditional birth attendant) and 7.4% of them still engaged in self-medication.

Table 4.17: Reported MCH practices adopted by mothers after receiving MCH information disseminated by health workers using ICT?

MCH Practices	Yes		No		Ranking
	Freq	%	Freq	%	
Visited the clinic I'm registered for antenatal and postnatal care/immunisation/family planning	773	83	158	17	1
Visited Traditional Birth Attendant	72	7.7	859	92.3	2
Visited Patent Medicine vendor / Self-medication	69	7.4	862	92.6	3
Adopted exclusive breastfeeding	89	9.6	843	90.5	4
Did not do anything	51	5.5	880	94.5	5

N=931

This result was authenticated by some mothers during FGD in the four states. For example a nursing mother in Kaduna stated that:

"I usually make phone calls to the nurse at the health facility to find out when the next injection for my baby will be available; this is because the vaccines are not always available at the health facility. But with the phone I can find out when the vaccine will be available. This has enabled me to visit the hospital habitually for my child's immunisation".

Equally in Ondo State a mother reported:

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"Because the matron and health rangers call us every time about our health and they remind us to attend clinics for antenatal care and TT (Tetanus) immunisation. I don't miss antenatal clinics, because if I don't go for clinics the matron will call or the health ranger may pay me a visit".

These views were contrary to what was reported by some mothers during FGD in Imo State. A comment by one of the participants during the FGD in Imo State indicates this: "I don't go to hospital often like before, when I went to hospital at the slightest impulse. Now I can easily access information about my health".

4.3.6 Research Question 6: What are the challenges encountered by health workers and mothers when using ICT to disseminate or receive MCH information?

To determine the challenges encountered by health workers and mothers when using ICT to disseminate or receive MCH information, data were gathered from the health workers and mothers through interview, questionnaire and FGD. The health workers identified the cost associate with the use of ICT for disseminating and receiving MCH information as a main challenge. With the exception of Ondo State, health workers sometimes bore the cost associated with the use of ICT channels, especially mobile phones and the Internet.

Apart from the cost associated with the use of ICT tools and services, health workers also expressed concern over unreliable power supply in the health facilities, especially when using laptops, projectors or DVD/TV during antenatal clinic. As a result, they usually missed the opportunity to use the ICT tools when there was power outage. This issue was highlighted in the four states. For example, a comment on the issue by one of the health workers affirms this: "We are usually unable to use projector/laptops during antenatal clinics when there is a power break. So we are left to do health talk (Face-to-face chat) without any ICT tool".

A challenge unique to Ondo State indicated by a health worker is the challenge of double registration. After the initiation of the *Abiye* programme, some mothers in the community saw the introduction of mobile phone for MCH care as an opportunity to own a phone for free, and not just to access MCH information and services. Thus, they end up registering in more than one health facility so that they could have a double portion of the Abiye delivery kit. Besides these three issues, the health workers were dissatisfied with the irrelevant or unexpected calls made by mothers to them (health workers) at odd hours.

A major challenge encountered by mothers when receiving MCH information disseminated through ICT was the problem of power supply (596, 64%). This was followed by poor network coverage (416, 44.7%). Table 4.18 presents the details of the challenges of using ICT to receive MCH information as indicated by the mothers.

Table 4.18:   Challenges of receiving MCH information disseminated by health workers through ICT

Challenges encountered	Freq	%
Unreliable power supply	596	64.0%
Poor network coverage /connection problem	416	44.7%
My income is low; I can't afford them	178	19.1%
Language of content	126	13.5%
My information and technology skill is low; I can't operate some of them	101	10.8%
My husband does not support using ICT	78	8.4%
Others (unstable Internet connection, low bandwidth)	20	2.1%

In order to further authenticate data collected with the questionnaire, the FGD sessions with the mothers was used to answer the question. They confirmed unreliable power supply as the most common problem they encounter when receiving MCH information from ICT channels. They also complained about not always having regular power supply to charge their mobile phones. This limited their use of mobile phones for receiving MCH information and resulted in their missing MCH radio and television programmes. Comments by the participants on challenges encountered when receiving MCH information are presented below:

A participant in Ondo State asserted that: "The problem I have with the use of mobile phone is that when there is no power supply where I live; it is usually difficult to recharge the phone. I always have to take the phone to the office for charging (Ondo State)".

A mother in Gombe State also stated that: "It is sometimes difficult to get the health facility because of poor network coverage. When this is not the case my phone battery may be low and I may not be able to recharge until late in the night when power is restored".

An issue that was raised in Imo State was the challenge of poor Internet service and affordability of the service. A few FGD participants indicated preference for the Internet because it is a robust source of MCH information which offers users the opportunity to access information at their convenience. They were however concerned about the cost of Internet access and unstable Internet services which prevented them from using the platform most of the time.

A mother during a FGD session in Imo State reported this: "I get information on health tips, exercise for pregnant women, what to expect throughout my pregnancy from the Internet. I do this often, especially when I miss TV or radio programmes. But it is sometimes impossible to use the Internet when the connection is poor or I'm unable to buy data bundle".

In addition, mothers also reported having issues with the clarity of messages received. Some of them have challenges replying text messages, as a result of low IT skill. There was also

the respondents' inability to track radio or TV programmes once they missed an episode, due to their busy schedule.

Two comments highlighting these issues are as follows: "When we were given the phone, we were taught how to use it to make calls and send messages. I have not been able to send text messages with the phone. I always ask my younger sister to help me. So most of the time, I always use the phone for calls only" (Gombe State).

"I receive phone calls and text messages from the health centre I'm registered. I make phone calls to the matron when I have a health need. But sometimes I am can't understand the message I receive. Sometimes they have some words I don't understand in the text. So I always have to wait for my husband or someone else to explain the content of the message" (Kaduna State).

With the exception of the mothers from Ondo State, all other respondents have problems with the cost implications associated with the use of mobile phones for communicating MCH information. They could not pay the cost of making calls most of the time. Three main challenges by the respondents: power problem, cost associated with the use of ICT and connection problem.

The respondents made some suggestions on how to overcome the challenges. While three of the suggestions were presented by the health workers, only one was provided by the mothers. First, to alleviate the problem of power supply, the health workers suggested the provision of laptops with double cell batteries to improve the use of laptops even when there is an interruption in power supply. Secondly, they recommended the use of toll free lines for out-patients to reduce the cost associated with the use of ICT. Thirdly, they advocated that government should make available ICT infrastructure in the rural areas and educate mothers on how to use them. This is in addition to providing. ICT facilities such as cyber café and viewing centres to subsidise the cost of ICT gadgets and charges attached to their use.

4.3.6 Research Question 7: What are the challenges encountered in adopting MCH practices disseminated by health workers using ICT?

The question was answered using the questionnaire administered on the mothers. As indicated by the respondents, moral and financial support from their husbands (215, 23%) was the major challenge hindering the adoption of MCH practices disseminated using ICT. Other challenges are presented in Table 4.19.

Table 4.19: Challenges encountered in adopting of MCH information promoted by health workers using ICT

Challenges of the adoption of MCH information	Yes	
	Freq	%
Religious belief	117	12.6%
Cultural belief system	175	18.8%
Husband support	215	23.1%
Language	136	14.6%
Format	104	11.2%
Others (low income, distance)	104	11.2%

N=931

4.4 Test of Hypotheses

Four hypotheses were tested in this study at 0.5 level of significance.

4.4.1 Hypothesis 1: Mothers' perceived health worker ICT use will not significantly affect the maternal and child (MCH) practices of Nigerian mothers.

Table 4.20 shows the test of the effect of mothers' perceived health workers ICT use on the MCH practices of mothers studied.

Table 4.20:   Correlation Analysis between mothers' perceived health worker ICT use and MCH practices of Nigerian mothers

Variables	N	R	P
MCH practices Mothers' perceived health worker ICT use	931	.258**	.000

** Sig at .05 level

Table 4.20 presents the Pearson Correlation Coefficient (r) indicating the relationship between mothers' perceived health workers ICT use and MCH practices of Nigerian mothers (0.258; P< 0.05). Since the P (0.00) value is less than 0.05 level of significance, the null hypothesis (H_{01}) was rejected. This means that there is a significant positive relationship between mothers' perceived health worker ICT use and MCH practices of Nigerian mothers studied. The implication is that mothers' perceived health workers ICT use positively influence mothers MCH practices.

4.4.2 **Hypothesis 2: There is no significant relationship between mothers' perception of ICT disseminated information and their MCH practices.**

Table 4.21 shows the test of the relationship between mothers' perceptions of ICT-disseminated information relevance and their MCH practices

Table 4.21:   Correlation Analysis between mother's perceptions of ICT-disseminated information and their MCH practices

Variables	R	P
MCH practices Mothers' perceptions of ICT-disseminated information	.313**	.000

** Sig at 0.05 level

The hypothesis as presented in Table 4.21 shows that the Correlation Coefficient (r) indicating the relationship between mothers' perception of ICT- disseminated information relevance and MCH practices of Nigerian mothers is 0.313; P< 0.05. Thus, there was a significant positive relationship between mother's perception of ICT- disseminated information relevance and maternal and child health (MCH) practices of Nigerian mothers (r = .313, N= 931, P < .05). Mothers' perception of ICT-disseminated information relevance had significant positive effects on their MCH practices. Hence, a significant positive relationship exists between the variables.

4.4.3 Hypothesis 3: **There is no significant relative effect of mothers' perception of health workers ICT use and ICT-disseminated MCH information on MCH practices.**

To ascertain the relative contribution of each independent variable to predict MCH practices of the mothers studied, all the independent variables investigated in this study were evaluated using regression analysis. The result of the analysis is presented in Table 4.22.

Table 4.22: Regression Analysis on the relative effect of mothers' perception of health workers ICT use and disseminated information relevance on their MCH practices

Model	Unstandardized Coefficient		Stand. Coefficient	T	Sig.	Remark
	B	Std. Error	Beta Contribution			
(Constant)	13.348	.900		14.823	.000	Sig.
Mothers' perceived	.254	.059	.134	-4.332	.000	Sig.
health workers ICT use	.239	.023	.320	10.360	.000	Sig.
Mothers' perception of ICT disseminated information						

The relative contribution of the two independent variables (mothers' perceived health workers ICT use and mothers' perception of disseminated information relevance) on the dependent variable (MCH practices of Nigerian mothers) is presented in Table 4.22, expressed as beta weights. Mothers' perception of ICT- disseminated relevance (β = .320, P <.05) made the highest contribution to MCH practices of mothers followed by mothers' perceived health workers ICT use (β = .134, P <.05). Hence, mothers' perceived health workers ICT use for MCH information dissemination and mothers' perception of ICT-disseminated MCH information relevance significantly and independently predicted MCH practices among Nigerian mothers.

4.4.4 Hypotheses 4: Mothers' perceived health workers ICT use, and ICT-disseminated MCH information will not significantly affect their MCH practices

To ascertain the joint contribution of the two independent variables to predict MCH practices of the mothers studied, all variables investigated in this study were evaluated using regression analysis. The result of the analysis is presented in Table 4.23.

Table 4.23: Summary of regression analysis showing the joint contribution of mothers' perceived health workers ICT use and mothers' perception of ICT-disseminated information relevance to MCH practices

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Model	Sum of Squares	DF	Mean Square	F	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig.	Remark
Regression Residual Total	1121.530 8549.101 9670.632	2 928 930	560.765 9.212	60.871	.341	.116	.114	3.0352	.000	Sig.

The regression correlation coefficient (R) indicating the joint effect of mothers' perceived health workers ICT use and their perception of ICT- disseminated information relevance on MCH practices was 0.341; R square (R^2) was 0.116 while the adjusted R square was 0.114(Table 4.24).

This implies that the two independent variables contributed only 11.4% to the variation in the MCH practices of Nigerian mothers studied. The remaining 88.6% could be due to other factors that were not considered in the study. Further verification, using regression analysis of variance

produced F-ratio of 60.871 tested at P< .05. The significance of the composite contribution was tested at P < .05. Since the P value was less than 0.05, the null hypothesis four was rejected. This implies that the joint contribution of the independent variables to the dependent variable was significant.

4.5 Discussion of Results

This section contains the discussion of the findings of the study.

4.5.1: ICT used by health workers for disseminating information on MCH in Nigeria

The findings revealed a high prevalence (708, 76.0%) of the use of mobile phones by health workers for disseminating information on MCH practices. In the states selected for the study, mobile phones were ranked highest by the mothers, followed by radio 623 (66.9%), and DVD/TV 513(55.1%). Other sources included ICT tools 254 (27.3%), such as laptop/ projectors, and Internet/computer 22(2.4%).

With reference to specific uses, the results showed further that mobile phones were used for appointment reminders, disseminating information on maternal and child health, referrals and consultations during emergencies. This result reflects the report of authors in similar studies conducted in Nigeria, where mobile phone was used for similar purposes, especially during obstetric emergencies (Fajembola, 2011; Oyeyemi; 2012; Onoriode et al. , 2012; Pathfinder,2015). This finding also supports the report of Idowu et.al. (2003) who indicated an increase in the rate of adoption of more recent ICT like mobile phones, especially in the developing countries. But the result does not align with the findings of Olatokun and Adeboyejo (2009) in a similar study in Nigeria which revealed the prevelance of laptops and projectors for supporting reproductive health care.In line with findings from the literature, the results obtained

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from the study revealed that the mobile phones were used because it reduces the barrier usually encountered by pregnant women as a result of distance. This is to ensure that mothers have access to health information without being limited by distance (Innovation, 2012).

The results obtained in this are study is slightly different from Parmar's (2009) report in India, where radio and television were not only popular but were also widely accepted. In the case of this study, radio was reported as very useful ICT channel ($\overline{X}$ =2.80), because it was widely used and accepted. This was followed by mobile phones ($\overline{X}$ =2.71) which was widespread in the four states because of its perceived usefulness by the respondents.

The variation in the results obtained may be due to technological advancement. As reported by Vital Wave Consulting (2009), the rate of adoption of recent ICT like mobile phone and the Internet grew in the last five years, especially with the expansion of mobile phone network in developing countries. This according to some authors (Cipresso, Serino, Villani, Repetto, Selitti, Albani, Mauro, Gaggioli and Riva, 2012) is responsible for the increase in the adoption of mobile technologies in different sectors of these countries.

4.5.2: Types of MCH information health workers disseminate to mothers using ICT

The health workers used ICT to disseminate a range of MCH information. Such information included appointment reminders (419, 45%), emotional changes (368, 39.5%), family planning (317, 34%), nutrition (305, 32.8%), medication in pregnancy (285, 30.6%), disease prevention (272, 29.2%), breastfeeding (242, 26%) and referrals/consultations (20, 2.1%).

However, appointment reminder was the most common type of MCH information disseminated by health workers using ICT. This corroborates the findings of Evan's et. al (2012) in a study on the Text4baby project in the United States and Grameen Foundation's (2011) evaluation of the Motech project in Ghana where the Internet and mobile phones were used to provide free MCH information, especially reminders for antenatal/postnatal visits to mothers to increase the quantity and quality of prenatal and neonatal outcomes.

A distribution of the type of MCH information disseminated by state shows that health workers in the states mostly used ICT for appointment reminders in Ondo, (266), Gombe (66) and Imo (34) states. This was followed by information on emotional changes in pregnancy, family planning and disease prevention respectively. The least disseminated MCH information was information on referrals and consultation during emergencies. While the findings from this study indicate that information on referrals and consultation were the least disseminated, results from previous studies by Musoke (2002) in Uganda, Mechael (2005) in Eygpt and Gurman's et. al on mhealth project in developing countries indicated that ICT was mostly used for consultations and referrals during emergencies, although its use for appointment reminders was also mentioned (Mechael, 2005; Iheed, 2011; Gurman et. al, 2012; Oyeyemi ,2012).

MCH information disseminated by health workers using ICT were in different formats, such as voice, text, picture and video. The voice format was the most used. This finding is in tandem with the results from other studies conducted in other African countries, which showed that MCH information was presented to mothers in all the formats mentioned by the mothers, with the voice format being the most popular. For example, in Malawi, 80% of the mothers received MCH information disseminated in the voice format (Cooper, 2013). This was also confirmed in Ghana by Intermedia's report in 2010 in which 70% of the women who participated in the study indicated preference for voice format from radio. However, for the Motech Project in the same

country (Ghana), both the voice and text format were accepted by the mothers. (Grameen Foundation, 2012).

4.5.3: Mothers' perceptions of the usefulness of ICT and relevance of MCH information disseminated by health workers

Mothers had positive perception of MCH information disseminated through ICT channels. They reported improved knowledge about health issues surrounding pregnancy and childbirth (mean = 3.62, SD=0.60). They were also of the view that the use of ICT-disseminated MCH information helped them to stay healthy in pregnancy (mean = 3.56, SD=0.68). This led to an improvement in their MCH practices (Mean = 3.51, SD=0.64) and enabled them to manage common health conditions in children (mean = 3.48, SD= 0.67). It influenced their health-seeking behaviour (mean = 3.47, SD=0.64) and also improved decision making about their health (mean = 3.46, SD=0.64). This implies that mothers' perception of the relevance of ICT-disseminated MCH information was positive, as MCH information from ICT channel was considered useful and adopted by the mothers to improve their health. This result is in line with Onoriode et. al (2012) findings in Gombe State, where positive perceptions were expressed by mothers on the MCH information from mobile phones. Mothers in Gombe confirmed an improved access to accurate MCH information and access to health care, although they did not confirm an improvement in their MCH practices.

Regarding mothers' perception of ICT, the study findings revealed that the sampled mothers had a positive perception towards the use of mobile phones. They also indicated a strong preference for traditional media (radio). This implies that mothers were more comfortable receiving MCH information from mobile phones and radio. Corroborating Parmar's (2009) submission in India, the finding highlights the importance of the traditonal media as widely accepted channels that have been in use for decades to deliver information on women's health.

But it differs from what was obtained by Castle et al. (2011) in another study in the northern part of Nigeria; their report indicated a negative disposition by mothers to the use of ICT (mobile phones) for receiving MCH information. As a result, most of the mothers in the rural area lacked willingness to participate in ICT-based projects for MCH. Although findings from this study confirms the popularity of mobile phone for disseminating MCH information, it did not indicate its total approval by the users. Some of the mothers reported being more comfortable with the traditional media (radio and television). This propably explains why the mean score of the frequency of use of radio (4.02) and televison (3.54) ranked high , as presented in (Table 4.8) the results section.

The inference that could be drawn from this is that perceptions about MCH information from ICT channels can vary from one region to the other. This flags a caution signal to developers of e-health projects to consider the perception of the target group when designing and implementing these projects. It also implies that the popularity of a particular ICT tool may not necessary indicate approval by the target group. This realisation probably informed Musoke's (2002) and Parmar's (2009) submission that ICT-based intervention for MCH in Africa should adopt both user-centric and multi-technology approach. That is, users' approval of technologies should be sought and an approach that adopts more than one ICT tool for health care should be considered when implementing e-health projects.

4.5.4: Influence of the use of ICT by health workers on MCH practices of Nigerian mothers

The finding in Table 4.17, indicate that a significant proportion (773, 83%) of the respondents reported an increase in the use of health facility after receiving MCH information. This is because the use of ICT for sending appointment reminders encouraged the mothers to use

the available MCH services. This result supports the findings from similar studies in Rwanda (Kalach, 2011), Kenya (Berg, Wairiero and Modi, 2009) and Malawi (Innovation, 2012) where the use of ICT for MCH information dissemination influenced mothers to attend more antenatal and postnatal visits, especially for those who might otherwise have avoided such practices. As a result, there was an increase in the number of facility deliveries.

A similar result was observed in Malawi by Cooper (2013) in his evaluation of the impact of an e-health project for MCH (Chipatala Cha Pa Foni Project -CCPF) involving women, their partners and health workers. The report indicated a positive influence of the use of ICT by health workers on the MCH practices of mothers. This led to an increase in the adoption of healthy practices such as exclusive breastfeeding of infants and improvement in nutrition practices of pregnant women.

Equally, sending appointment reminders and information on vaccination, as observed in Every Child Count project (Berg, Wairiero and Modi, 2009) and MOTECH project in Ghana (Grameen Foundation, 2011) influenced mothers to attend more antenatal and postnatal visits, especially for those who might have avoided such MCH practices. Similarly, in Rwanda, the use of mobile phones for sending text messages on MCH information led to an increase in antenatal visits and utilisation of health facilities because appointment reminders and alerts on child nutrition were sent to the mothers' phones. Consequently, facility deliveries increased from 342 per month to about 400 per month. The number of home deliveries was also reduced from 104 per month to 65 per month (Kalach, 2011).

4.5.5: Challenges of disseminating or receiving MCH information using ICT

The respondents identified some of the barriers hindering the use of ICT for disseminating and receiving MCH information. A major issue raised by the respondents was the problem of unreliable power supply. Unreliable power supply is a major problem encountered in Nigeria and many developing countries. The health workers reported that they usually missed the opportunity

to use projectors/laptops during antenatal clinics and were usually unable to recharge their phones when there was power outage.

A significant proportion of the mothers (596, 64.0%) also identified unreliable power supply as a major challenge they encountered when using ICT to receive MCH information. Due to this challenge, mothers complained of missing TV programmes as a result of power failure. The result is similar to what was presented in reports on evaluation of similar projects for MCH in some African countries, like Gambia, Congo, Malawi, Mozambique and Uganda (Musoke, 2002; Cole-Ceesay et. al 2010; Corker, 2010; Cooper, 2013). This presupposes that if power supply continues to pose a serious challenge to the use of ICT for MCH care, it is important that implementers of e-health project provide alternative power sources, such as portable power banks (for mothers), solar systems and inverters (for the health facilities), to ensure effective MCH information dissemination using ICT.

Another constraint identified by the participants was the poor network coverage and problem of poor Internet connection (416.44.7%) which has been linked to poor ICT infrastructure and low bandwidth. The cost implications of Internet access made most users to subscribe to a lower bandwidth option, mostly accessing the Internet from their phones. This option usually makes accessing MCH information from the Internet unsteady and slow, hence frustrating users. Poor network coverage is another issue which limits access to MCH information from ICT platforms. Because the network coverage of some of the mobile phones and Internet service providers is limited; communicating MCH information becomes difficult, especially for people in remote places in the rural areas of the country. This confirms Valliere et.al (2012) report in Sierra Leone where poor network coverage by mobile phone services providers was identified as a major challenge affecting the use of ICT by health workers, as well as the mothers. This challenge was also highlighted by Mehl (2010) in his presentation in Geneva at the ITU conference on e-health projects in rural communities.

Apart from the challenge with power and Internet connection or poor network coverage, another problem reported by the participants is the cost implications associated with the use of ICT channels. The issue was raised by both the health workers and mothers. The respondents identified cost as a barrier (during the interview and FGD sessions) except in the state (Ondo State) where the cost was subsidised by the government. This finding is in tandem with Kaba et al. (2008), who viewed the cost factor as a major determinant of the use of ICT for health care. This is unlike what is available to mothers enrolled in an e-health project (Text4baby) in the USA where mothers sign up for a free SMS service for the duration of their pregnancy (Evans et al., 2012). Likewise, in Ghana, the Motech project also provided free MCH information services to mothers to increase the quantity and quality of prenatal and neonatal outcomes in rural Ghana (Grameen Foundation 2012).

The situation is slightly different in Nigeria. Health workers and mothers are sometimes expected to bear the cost associated with the use of ICT (Onoriode et. al, 2012; Castle et. al 2012), except in situations where the e-health project was designed in such a way to take care of the cost. Out of the four states, it was only in Ondo State (Abiye project) that the cost of using ICT was handled through a public-private arrangement (Fajembola, 2012; Oyeyemi, 2012). In the other states, after phones were given free-of-charge, other evolving costs were sometimes borne by the health workers and mothers. The result of a study conducted in Lagos State Teaching Hospital by Balogun et al. (2012) underscored the effect of cost on the use of phones for disseminating MCH information. The result of the study indicated a positive disposition by health workers and mothers to the use of ICT for receiving MCH information. However, the study also revealed that they were not willing to bear the cost of messaging services (SMS).

To expand the use of ICT for receiving and disseminating MCH information, it is important that an implementation model (may be a public private partnership model) that will alleviate the cost burden associated with the use of ICT channels be adapted to encourage the use

of the platform. Schweitzer and Synowiec (2012) in their study on the economics of e-health and m-health across the globe stressed the need to come up with a model that can absolve the costs of e-health at different levels of health delivery systems to encourage more investment in e-health and the use of ICT for health care. Otherwise, health workers and mothers may not totally embrace the use of ICT for MCH care.

The time factor was another issue that affected the use of ICT for disseminating or receiving MCH information. Because of their busy schedule, mothers were sometimes unable to track radio or TV programmes. Wrong timing of phone calls was also reported; health workers reported that some mothers made irrelevant calls to them at odd hours. This could discourage health workers from using ICT platforms for communicating MCH information.

4.5.6: Challenges of adopting MCH information disseminated by health workers using ICT

A major challenge that hindered the adoption of safe MCH practices by the mothers was support (moral and financial support) from their husbands. Mothers considered financial support (allowance for transportation to health facility) and moral support as very important factor that could encourage them to adopt safe MCH practices. This report has been confirmed by authors in similar studies conducted in the country. Onasoga, Afolayan, and Oladimji (2012), in a survey in Osun State, identified affordability of antenatal services, lack of knowledge about the existing services in antenatal clinics and husband's acceptance of the services rendered as the major factors influencing the adoption of safe MCH practices in the state. Similarly, Ogunjuyigbe, Ojofeitimi, and Liasu (2009), in a survey on the uptake of contraceptives in south-west Nigeria, underscore the importance of husband's support for women in adopting healthy practices, especially family planning methods. The study revealed that men have a significant role to play in the adoption of contraceptives. About 37% of the respondents reported joint decision- making on when to have

another child, 40.8% on whether to stop having children, and 44% on what to do to stop childbearing.

Other barriers, such as cultural belief system (215, 23.1%), language (136, 14.6%), religious belief (117, 12.6%), format (104, 11.2%) and other challenges (like low income, distance and lack of awareness) hindering the adoption of safe MCH practices have also been highlighted in previous studies. Nwosu, Urama, and Uruakpa (2012), in a nationwide study in Nigeria, argued that level of income has effect on the adoption of safe MCH practices. The study further confirms a positive relationship between household wealth status and the number of antenatal visits. In Oyo state, Dairo and Owoyokun (2010) discovered an association between religious beliefs and adoption of safe MCH practices. Findings from the study indicated that Muslim mothers and women in other religions were more than two times likely to attend antenatal clinics than women who were Christians.

In addition, Thompson et al. (2010), in an e-health project in Kaduna State identified language as a major barrier to the successful implementation of the project. According to Gurman, Rubin, and Roess (2012), to ensure the effectiveness of MCH information disseminated using ICT, providing messages in local languages may be more beneficial to the target group (mothers). Information products from ICT that takes into consideration the language of the audience would be more relevant and can promote the adoption of health practices by the target group.

These findings indicate that husbands, language, mothers-in-law and religious beliefs play vital roles in encouraging the adoption of safe MCH practices disseminated using ICT tools, as support from these influencers or conflicting positions may hinder the adoption of safe MCH practices by mothers.

The findings also imply that women should no longer be the only target group for ICT-based projects focusing on MCH. It is important for designers of future e-health projects for MCH to evolve a module for influencers (such as husbands, mothers-in-law, religious leaders), with

special focus on the promotion of communication between a husband and a wife on reproductive health matters. This is in line with Kaba, N'Da and Mbarika, (2008), cited in Tibenderana et al. (2010), where social influence was identified as a major determinant of ICT acceptance and use of ICT in an African setting (Uganda). This was also confirmed by Miller's ((1976) and Venkatesh and Morris' (2000) in their submission that women find others' opinion and social influence significant when forming an opinion to use technology. However, Tibenderana et al. (2010) also noted that these results are contrary to what was obtained in similar studies in developed countries. This implies a cautious application of knowledge derived from acceptance and use of technology in developed countries by the developing ones.

In order to overcome this challenge (lack of support from influencers), Mehl et. al, (2010) suggested the promotion of MCH services in religious setting and rural areas amongst opinion leaders, young and older women to ensure the adoption of safe MCH practices promoted by health workers through ICT. This submission was also supported by iheed (2011), who stressed the need for content of m-health messages to be developed in a collaborative way, by sharing best practices to ensure effective use of ICT for health promotion.

4.5.7: Relationship between mothers' perceived health worker ICT use and maternal and child (MCH) practices of Nigerian mothers

The findings on the influence of the use of ICT on MCH practices indicate that the use of ICT for MCH information dissemination significantly influences MCH practices. A test of the relationship between the independent variable (Mothers' perceived health workers ICT use and disseminated information relevance) and the dependent variable (maternal and child health practices) indicated that a significant positve relationship existed between the variables. On this

premise, the first hypothesis was rejected. This implies that mothers' perception of the use of ICT by health worker for MCH information dissemination can influence them to adopt safe MCH practices promoted using ICT.

This result corroborates the findings from previous studies by Kalach(2011), Berg, Wairiero and Modi (2009) where the use of ICT for MCH information dissemination influenced mothers to adopt healthy practices such as regular antenatal and postnatal visits, exclusive breast feeding and improvement in feeding habits of pregnant women.

The implication of this is that Nigerian mothers would adopt safe MCH practices such as regular antenatal and postnatal visits and completion of routine immunisation, family planning etc., if relevant MCH information is disseminated to them by health workers using acceptable ICT channels. This is provided that issues concerning personal characteristics, social influence and facilitating conditions were addressed at the design phase of e-health projects (Venkatesh et al., 2003).

4.5.8: Relationship between mothers' perception of ICT-disseminated information relevance and MCH practices

A test of the relationship between mothers' perception of ICT- disseminated information relevance and MCH practices using the Pearson's Correlation Coefficient (R) indicated a significant positive relationship between the two variables (r = .313, N= 931, P < .05). As a result, the second hypothesis was rejected. This implies that mothers' perceived relevance of information on safe MCH practices from ICT can influence their adoption of safe MCH practices promoted through ICT

Therefore, willingness to use technology as source of health information may be dependent on mothers' perception of the channel and information emanating from this source.

This can make or mar ICT-based (e-health) programmes for MCH. The Unified Theory of Acceptance and Use of Technology (UTAUT), illustrates how the perceived usefulness of information disseminated could have profound influence on health information seeking behaviour, which is further influenced by the ease of use and convenience of the type of ICT tool and other factors such as social influence, facilitating condition and control factor (Venkatesh et al., 2003). This consequently, affects the adoption of safe MCH practices by mothers. Therefore, it is important to investigate the perceptions of mothers when evolving ICT-based programmes for MCH to ensure acceptance and use of ICT channel and health information disseminated.

4.5.9: Relative effect of mothers' perceived health worker ICT use use and disseminated information relevance on their MCH practices.

The relative contribution of the two independent variables (Mothers' perceived health workers ICT use and ICT-disseminated information relevance) on the dependent variable (MCH practices of Nigerian mothers) indicates that mothers' perception of ICT- disseminated information relevance made the highest contribution to MCH practices of mothers followed by mothers' perceived health workers ICT use for MCH information dissemination. Hence, Mothers' perceived health workers ICT use and perception of ICT-disseminated information relevance significantly and independently predict MCH practices among Nigerian mothers.

This is in line with previous findings and the submission of the postulators of the UTAUT (Teo, 2001, Venkatesh 2003). The implies that mothers will not only use ICT to receive MCH information but; they will also adopt MCH information from ICT once they are convinced that it will be easy to use as well as beneficial (relevance).

4.5.10: Joint contribution of Mothers' perceived health workers ICT use and disseminated information relevance on MCH practices

In this study, the regression analysis indicated that the two independent variables: mothers perceived health workers ICT use and disseminated information relevance, significantly affected MCH practices. Hence, the fourth hypothesis was rejected. This result shows that the two independent variables motivate mothers to adopt healthy MCH practice. This is consistent with previous empirical research and the submission of the postulators of the Technology Acceptance Model 3 (Teo, 2001, Venkatesh 2003). The implication is that people will adopt a technology or an information system once they consider it beneficial and easy to use.

The findings indicate that if health workers do not promote healthy MCH practices using ICT, mothers may not be aware of the available MCH information and services. Therefore, there is the need to expand the use of ICT for MCH care in Nigeria to encourage more Nigerian mothers to adopt safe MCH practices as well as improve the efficiency of health workers involved in the care of women and children to significantly reduce maternal and child mortality.This implies that the combination of the two variables (mothers' perceived health workers ICT use and disseminated information relevance) has significant effect on MCH practices of Nigeria mothers.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

1.1   Introduction

The chapter presents the summary of findings, conclusion and recommendations of the study. It also captures the contribution of the study to knowledge and suggestions for future research.

5.2   Summary of findings

The major findings of the study are as follows:

1. Information and communication technology tools used by health workers for disseminating MCH information in the selected states were mobile phone, radio, DVD/TV, Internet/computer and laptops/projector).

2. The MCH information disseminated by health workers using ICT included information on emotional changes in pregnancy, family planning methods, nutrition in pregnancy, disease prevention/medication in pregnancy, breast feeding and appointment reminders.

3. Mothers' perception of the usefulness of ICT and MCH information from the channel was positive. Mobile phone was the most useful ICT tool followed by radio. However, mothers' perception of DVD/TV and Computer/Internet was negative.

4. The use of ICT for disseminating information on safe MCH practices as reported by the mothers mostly influenced the adoption of MCH practices like family planning, nutrition in pregnancy, antenatal/postnatal visits and immunization.

5. MCH practices adopted by mothers after receiving MCH information are regular antenatal visits, postnatal visits, immunization, family planning and breastfeeding; although very few of the mothers still visit the traditional birth attendants.

6. Challenges to the use of ICT for disseminating or receiving MCH information were unreliable power supply, poor network coverage and cost.

7. The challenges hindering the adoption of ICT-disseminated MCH information by mothers include lack of support from their husbands, cultural belief system, language, religious beliefs, format of MCH information and other issues (such as low income and distance).

8. Mothers' perceived health workers ICT use for MCH information dissemination was found to have significantly influenced MCH practices of Nigerian mothers.

9. Mothers' perception of ICT-disseminated information relevance was also found to significantly influence their MCH practices.

10. Mothers' perceived health workers ICT use and mothers' perception of ICT-disseminated information relevance significantly and independently predict MCH practices among the mothers studied.

11. Mothers' perceived health workers ICT use and ICT-disseminated information relevance when taken together would significantly predict maternal and child health practices of mothers.

5.3   Conclusion

The use of ICT by health workers for promoting safe MCH practices improves the adoption of safe MCH practices. A positive relationship exists between mothers' perceived health workers ICT use, their perception of ICT-disseminated information relevance and the adoption of safe MCH practices by Nigerian mothers. Hence, it is important to replicate harmonized and integrated e-health projects that can be implemented across the country to realize the full benefits

of ICT for MCH. The low use of ICT such as Internet and television indicate the need to improve power supply and supportive ICT infrastructure to improve the use of ICT for MCH care.

The study also shows that mothers will also adopt MCH information promoted through ICT once they are convinced its relevance to their needs. This is provided issues such as personal characteristics, social influence and facilitating conditions are adequately addressed by information experts at the design phase of ICT-based projects. Therefore, to effectively promote MCH information dissemination, as well as the adoption of safe MCH practices by Nigerian mothers; there is a need to scale up the use of ICT (mobile phones) for health promotion campaigns for maternal and child health in the country.

5.4   Recommendations

The findings of the study indicate that mothers are positively disposed to receiving MCH information from ICT (phone and radio). The study also confirms that the use of ICT for MCH information dissemination influences MCH practices of mothers. Based on these findings, the following recommendations were made:

1. The Nigerian government needs to scale up the use of ICT for MCH information dissemination at all levels of care to cover all mothers and health workers. Pregnant women, nursing mothers, health workers and health facilities in Nigeria should be adequately equipped with ICT infrastructure; such as, mobile phones as well as toll-free lines for out-patients and radio programmes that would promote maternal and child health.

2. The findings of the study indicate that mothers prefer MCH information in their dialect. Therefore, developers of e-health projects for MCH should take into consideration the

indigenous languages of mothers when developing information products for e-health interventions. This would help improve the adequacy of information products for MCH.

3. To overcome the challenge of cost, ICT-based project for MCH should be integrated into the corporate social responsibility activities of telecommunication companies in Nigeria. This will help to subsidise the cost of ICT gadgets and the charges attached to their use.

4. Since support from husbands was identified as a major challenge affecting the adoption of ICT-disseminated MCH information; developers of future e-health projects should involve influencers such as husbands and mothers-in-law. MCH information products or messages which can also be disseminated to these influencers.

5. To overcome the challenge of unreliable electricity supply, stakeholders promoting MCH should provide alternative power supply such as solar energy, inverters or generators. In addition, portable power banks can also be provided for mothers for charging their mobile phones.

6. ICT-based projects for MCH should be hinged on providing culturally appropriate MCH information to meet the needs of mothers at all stages along the continuum of care, as recommended by the World Health Organisation.

5.5 Contributions of the study to knowledge

ICT tools used by health workers for maternal and child health information dissemination in public health facilities in Nigeria are mobile phones, radio, television/digital video and Internet/computer. Mothers' positive perception of MCH information disseminated through ICT will improve their adoption of safe health practices. It is essential to re-package MCH information to remove barriers associated with language and cultural practices that may hinder the adoption of safe MCH practices promoted through ICT. To maximize the gains of ICT for maternal and child

health, it is important to sustain the dissemination of MCH information by ensuring regular power supply and non-interference of cultural practices.

The research model presented by the study highlights the relationship amongst variables of the study (mothers' perceived health worker ICT use by health, disseminated information relevance and the adoption of safe MCH practices). This model indicates that mothers perceived health worker ICT use and disseminated information relevance can influence the adoption of safe MCH practices, provided issues such as social influence and facilitating conditions were addressed at the design phase of e-health projects. The model can be adapted by scholars for future research on the use of ICT by health workers for health promotion.

5.6   Suggestions for further research

The study is not exhaustive as it did not consider all factors that can determine the effectiveness of the use of ICT by health workers on the maternal and child health practices of Nigerian mothers. The following areas are therefore suggested for further research:

1. The study can be replicated in private health facilities in the country that implement similar projects for MCH in Nigeria.

2. Future research can also focus on content analysis of e-health information products disseminated to mothers. This should take into consideration the language and clarity of messages disseminated to mothers.

3. Effect of the use of ICT by health workers on their attitude to work can also be investigated. This would provide information which could be used to ensure the use of ICT for MCH care in a realistic manner.

4. The role of influencers, such as husbands, mothers-in-law and religious leaders in the adoption of MCH information using ICT could also be investigated. This is to ensure that

the use of ICT for MCH care is deployed in a manner that could promote the adoption of healthy behaviours by Nigerian mothers.

5.7 Limitation of the study

Data for the study were collected from pilot e-health initiatives for MCH in public health facilities in the country. As a result, findings from the study may be insufficient for generalisation. However, the study presents a significant part of the e-health interventions and maternal and child health scenario in Nigeria, since majority of mothers belong to poor or low income bracket of the population who cannot afford the high cost of private health services.

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Appendix I

DEPARTMENT OF LIBRARY, ARCHIVAL AND INFORMATION STUDIES

FACULTY OF EDUCATION

UNIVERSITY OF IBADAN

Date:

RESEARCH QUESTIONNAIRE FOR MOTHERS

Dear Respondent,

I am a PhD student in the Department of Library, Archival and Information Studies (LARIS), University of Ibadan. Your kind assistance in completing this questionnaire as accurately as possible will be appreciated. Please note that your participation in this study is voluntary and all information provided will be treated confidentially and used for research purposes only. The success of this study depends on your participation.

Thank you for your co-operation.

Obasola Oluwaseun (Mrs.)

SECTION A: DEMOGRAPHIC PROFILE OF THE RESPONDENTS

Instruction: Please answer the questions by ticking a pair of brackets, circling a number or filling the gaps. Multiple answers are only allowed when explicitly stated.

1. Occupation --

2. Husband's Occupation --

2. Age: -- years (as at last birthday)

3. Religion: Islam ( )   Christianity ( )   Others (Please specify) --------------

4. Ethnic group: Hausa ( ) Ibo ( ) Yoruba ( ) Others ( )

4. Marital status: Single ( )   Married   ( )

5. Education: Sch. Certificate and above ( )   below School Cert   ( )   Illiterate

6. Area of residence: Urban ( )   Rural ( )

7. Income level: < N20000 per month ( ) N20000- N50000 ( )   N50000-100000 ( )>100000 per month ( )

8. Is this your first pregnancy? Yes/No. If no, go to Question 9

9. Please state the number of children you have. 0 ( ) 1( )   2( )   3( )   4 ( )   > 4( )

SECTION B: (ICT USE)

MATERNAL AND CHILD HEALTH (MCH) INFORMATION DISSEMINATED USING ICT.

1. What type of ICT do health workers at the facility you are registered use for MCH care?

   Please tick the type of ICT used Mark as many as are appropriate

   (a) Mobile phones (b) email/computer (c) DVD/TV (d) radio (e) Others ----------

   2. What type of MCH information do you receive from these health workers? Mark as many
      as are appropriate.

(a). Nutrition during pregnancy (b) Appointment reminders (c) Family planning methods (d)

   Disease prevention in pregnant (e) Breast feeding (f) Medications in pregnancy (g)

   Emotional changes in pregnancy (h) Others (Please specify) ----------------------------

3. What is the format of the information received via ICT? (a) Voice (b) Text message

   (c) Pictures (d) Others -----------

2   Which of the format in Qsn. 6 is most preferred? (a) Voice (b) Text message(c) pictures (d)

   Others -----------

3   How often do you receive MCH information via ICT?

Information sources	Daily	Twice a Week	Once a week	Once a month	Never
Radio					
Television					
Mobile phones					

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The Internet					
Others					

6. What MCH practice did you adopt after receiving information received from ICT channel?

     a) Visited the clinic I'm registered for ANC/PNC/Imunisation, family planning

     b) Visited a Traditional Birth Attendant

     c) Self-medication/ Patent Medicine Vendor

     d) Adopted exclusive breastfeeding

     e) Did not do anything

SECTION C: MOTHERS' PERCEPTION OF DISSEMINATED INFORMATION

PERCEPTION OF USEFULNESS OF ICT AND MCH INFORMATION DISSEMINATED

VIA ICT.

Instruction: Please tick to indicate your Agreement or Disagreement with the following statements where strongly agree =A and disagree=D

Mothers' Perception of the usefulness of MCH information from ICT channel	A	D
A. Positive perceptions		
1.Using ICT disseminated information has improved my knowledge about health issues surrounding pregnancy and child birth.		

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2.Using ICT disseminated health information has improved decision making about my health.		
3. Using ICT disseminated information has improved my MCH practices (Breast feeding habit, family planning methods, ANC visits, postnatal visits, immunisation etc.)		
4.The use of ICT disseminated health information has improved my use of health facilities		
5. The use of ICT disseminated information has helped me to manage common health conditions (cold, malaria, diarrhea etc) observed in pregnancy		
6. The use of ICT disseminated information has helped me to manage common health conditions in newborns and children		
7. Using ICT disseminated health information has improved my health-seeking behaviour (knowing what to do and where to get help when in need of health care)		
9. Over all use of ICT disseminated MCH information has helped me to stay healthy in pregnancy		

10. Instruction: Please rate the usefulness of ICT for communicating MCH information on a three-point scale. With 1 = Very Useful, 2= Useful and 3 = Not useful

Perception of the usefulness of ICT for receiving MCH information	1	2	3
Radio			
DVD/TV			
Computer and Internet			
Phones			

SECTION D: MCH PRACTICES

Instruction: Please tick to indicate your Agreement or Disagreement with the following statements. Where strongly agree =A and disagree=D

Maternal health practices adopted by mothers	A	D
1. Use of ICT by health workers has reduced time spent seeking antenatal services		
2. Use of ICT by health workers reduced time spent seeking postnatal services		
3 Use of ICT by health workers has helped me identify where and when to seek medical help		
4. Use of ICT by health workers for disseminating MCH information has helped improve my MCH practices (feeding habit during pregnancy, Breast feeding, family planning		

5. Use of ICT by health workers for appointment reminders made it possible for me to complete the expected number of attendance at antenatal and postnatal clinics.		
6. Use of ICT by health workers for appointment reminder helped me in completing the routine child immunisation for my baby		

7. Which of the ICT channel below is most influential on your MCH practices?

Most influential ICT channel on MCH practices	SA	A	SD	D
i. Radio				
ii. DVD/TV				
iii. Computer/Internet				
iv. Phones				

SECTION E: BARRIERS TO RECEIVING ICT DISSEMINATED HEALTH INFORMATION AND ADOPTING MCH PRACTICES PROMOTED VIA ICT

1. What are the barriers you encounter when using maternal health information from ICT sources such as radio, television, the Internet, phones? Mark as many as are appropriate?

   a. Unreliable power supply

   b. My IT skill is low; I can't operate some of them.

c. My income is low; I can't afford them.

d. Poor network coverage

e. Language of content

f. My husband does not support using such channels

g. Others (Please specify) -------------

2. Which of these factors pose a challenge to your adopting information on MCH practices disseminated via ICT? (a) Religious belief (b) Cultural belief system (c) Husband support (d) Language (e)Format (f) Others ----------

Appendix II

FOCUS GROUP DISCUSSION GUIDE FOR MOTHERS AND PREGNANT WOMEN

Ice breaker: Please think back to when you first became involved with the programme. What were your first impressions about the e-health project? Probe for the views about the use of ICTs.

Theme 1: Perception of mothers of ICT disseminated MCH information

1. What kind of health information do you receive via the ICT and how often do you get information via ICT (radio, TV, internet)

2. What do you think about MCH information disseminated by health workers via this channel? Probe

- Whether the health information disseminated is meeting their information needs,

- The adequacy of content, language, and most preferred format of the MCH information being disseminated.

- Find out other health information not supplied but are needed by participants

3. What is the best way of sending MCH information to you via ICT (the Internet, radio, TV, phones)?

Theme 2: Mothers' Perception of the Influence of ICT use by health workers for information dissemination on MCH practices information dissemination on MCH practices

4. In what way has your experience in pregnancy been different because of your participation in the e-health project in the facility you are registered?

5. What difference has been observed after your enrolment in the e-health project by mothers and pregnant women? Probe for influence on antenatal/postnatal services, health seeking behaviour and making informed decisions about their health?

Theme 3: Challenges encountered receiving health information via ICT

6. What are the challenges encountered using ICT for receiving information on maternal health? Probe for other challenges of the e-health project too.

7. How can these be tackled?

8. How do you think the use of ICT for disseminating MCH information could be improved? (probe for effect of subsidies and improvement in packaging of information)

9. Is there anything else about the use of ICT for receiving health information that you want us to discuss?

Closure of the discussion group

- Bring together patterns and consensus that evolved during the group discussion.

- Present a short summary of discussion back to the group and confirm opinions about issues discussed.

Appendix III

INTERVIEW GUIDE

I am conducting a study on the above topic for a doctoral degree. Your kind assistance in providing required information as accurately as possible will be appreciated. Please note that your participation in this study is voluntary and all information provided will be treated confidentially and used for research purposes only. If you will agree, this interview will be recorded on audio tape.

Thank you in anticipation for your participation in this interview.

Obasola O.I. (Mrs.)

SECTION A: DEMOGRAPHIC PROFILE OF RESPONDENTS

1. Name of your Organisation ---

2. a. Department: --

   b. Designation: --

3. What is your specialty? ---

4. Age: --- years (as at last birthday)

5. Gender: Male ( )   Female ( )

6. Marital status: Single( )   Married ( ) Others (Please specify) --------------

7. What is your highest educational degree? BSc. ( ) RN ( ) Diploma ( ) Others (Please specify) ---

8. Apart from your educational degree, do you have additional qualification/training?Yes/ No

9. If yes to Q 8, please give details --

10. Current Designation (Please specify) --

SECTION B: USE OF ICT FOR INFORMATION DISSEMINATION ON MCH BY HEALTH WORKERS

Theme 1: Use of ICT for information dissemination by health workers in MCH projects

1. What are the methods used in this health facility for disseminating MCH information?

2. Please discuss the use of ICT for disseminating MCH information in your facility. Probe for use of ICT for the following:

   a) Information dissemination on maternal and child health

   b) Consultations during labour or emergency (Knowledge enhancer)

   c) Use for referrals in emergency

   d) Appointment reminders for mother and child

3. Do you think the use of ICT for disseminating MCH information is effective?

   Probe for why they think the use of ICT is effective or not. Probe for the most effective ICT

4. What services are provided through the Abiye or Conditional Cash Transfer project?

i. What is your specific role in relation to the ICT-based project for maternal and child health?

5. Apart from the Abiye or CCT project discussed above, please discuss other applications of ICT for phones for MCH in your facility.

Theme 2: Influence of the use of ICT for health information dissemination on MCH practices

6. What are the results/outcomes you have observed in this health facility since the introduction of ICT (phones/computers) for MCH care and health information dissemination?

7. What changes in the MCH practices of mothers/health workers have developed as a result of ICT for the delivery of MCH information and services? Probe for influence on routine delivery services, ANC services, referrals and as knowledge enhancer

Theme 3: Challenges encountered when using ICT to disseminate health information

8. What are some of the key challenges regarding the use of ICT for information dissemination in the Abiye or CCT project? Probe for other challenges regarding use of ICT phones for MCH care

9. How do you think the use of ICT for disseminating MCH information could be improved?

10. What additional information would you like to share? What questions do you have for me?

Appendix IV

Box   1

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5th Week

In the past our ancestors did not know the effects of certain foods on the unborn baby and pregnant mother, so they prevented pregnant women from indulging in them. Nowadays, health professionals have looked into these and seen that they are not harmful to the pregnant woman or the baby. For example, people may have told you not to eat eggs, meat, fruits, okro, and other foods during pregnancy; otherwise the child would become a thief. Yet, there are no proven harmful effects on a baby's life from eating these foods. Rather they contain nutrients that are very important for the healthy development of your baby and you should eat lots of these foods.

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Box 2

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13th week

You need iron because it keeps your blood doing its job of carrying food and oxygen around your body to keep it well. When you don't have enough iron you may feel tired and breathless too often. You could also get a condition called anemia, which can be dangerous for you and your baby. A baby who does not have enough iron is often born too small and so they face a lot of risks. To avoid this, it is important that you take the tablets given to you by your midwife. Iron is also found in many foods including liver, red meat, green leafy vegetables such as ayoyo, ademe, gboma, kontomire, spinach, bokoboko, bitter leaf, and eggs. Try to also take fruits such as orange, guava or baobab fruit these help the iron to enter your blood more easily.
At this stage your baby is still small enough to fit into the palm of your hand. He or she is becoming more active – maybe even playing with the umbilical cord – grabbing it and letting it go. You might start feeling your baby move soon. This is called 'quickening'. At first, you might feel a slight movement low down in your belly. Some women feel their baby move later. If you haven't noticed anything yet, there is no need to worry but if you feel your baby moving, tell your midwife at your next appointment – share the good news!

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Appendix V

Table 3.4: Measurement of variables for achieving specific objectives

Obj	What to measure	Measurement indicators	How it was measured	Analysis
1	The types of ICT do Nigerian health workers use to disseminate information on safe MCH practices	• The use of ICT tools like phones, radio, television and Internet by health workers for disseminating MCH information to mothers involved in the selected e- health projects. • ICT tools used for receiving MCH information by mothers involved in the e-health projects.	• The responses from health workers during in-depth-interviews, identifying ICT tools used for disseminating MCH information. • Mothers' responses from the survey and FGD identifying the ICT tools used by health workers in the selected health facilities for MCH information dissemination.	Frequency counts and percentages
2.	The types of MCH information are disseminated to Nigerian mothers by health workers Using ICT	Information on • Family planning • Nutrition in pregnancy • Appointment reminders • Immunisation • Breastfeeding • Emotional changes	• Mothers' responses from the questionnaire and FGD which indicate the different type of MCH information health workers disseminate. • Health workers' responses during the in-depth-interview which indicate	Frequency counts and percentages

			MCH information they disseminate to mothers.	
3	Mothers' perception of usefulness of ICT and MCH information disseminated from ICT channels	• Mothers' perceived usefulness of MCH information from ICT channels • Mothers' perceived usefulness of ICT channels used for MCH information dissemination	• A Perception scale measuring mothers' perceived usefulness of MCH information from ICT was used. • A Perception scale measuring mothers' perceived usefulness of ICT channel used for disseminating MCH information.	Percentages, mean and standard deviation
4	The effect of the use of ICT by health workers on mothers' MCH practices	• Mothers' perceived influence of the use of ICT on 2. Immunisation 3. ANC/Post-natal visits 4. Family planning 5. Breastfeeding 6. Nutrition in pregnancy • Hypothesis one (HO1)	• Perception scales measuring mothers' perceived influence of the use of ICT on MCH practices • Mothers' perceived influence of the use of ICT on MCH practices obtained during focus group discussions. • Test of HO1.	Mean and standard deviation Correlation Analysis (Pearson's Product Moment Correlation - PPMC)

		•		
5	identify the MCH practices mothers adopt after receiving MCH information from health workers through ICT;	1.Immunisation 2. ANC/Post-natal visits 3.Family planning 4.Breastfeeding 5.Nutrition in pregnancy	Mothers responses on the MCH practices adopted after receiving ICT-disseminated MCH information	Frequency counts and percentages
6	Challenges encountered when using ICT to disseminate or receive MCH information.	Challenges experienced when receiving MCH information from ICT • Power problem • Poor network coverage • Low income • Low IT skill • Language problem • Husband support Other	Health workers and mothers' responses from the survey identifying the issues which constitute barriers to using ICT for disseminating or receiving MCH information	Frequency counts and percentages
7	Challenges encountered when adopting MCH practices promoted using ICT	Challenges encountered when adopting ICT disseminated MCH information • Religious belief • Cultural belief • Husband support	• Mothers' responses from the survey identifying the issues which constitute hindered the adoption of MCH practices disseminated using ICT	

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		• Language		
		• Format		
		Others (distance low income etc.)		
8	The relationship between mothers' perception of usefulness of ICT disseminated MCH information and their MCH practices.	Hypothesis Three • HO2: There is no significant relationship between mothers' perception of ICT disseminated MCH information and their MCH practices.	• The test of HO3	Correlation Analysis (Pearson Product Moment Correlation - PPMC)
9	Determine the relationship between the use of ICT for MCH information dissemination by health workers and mothers' perception of ICT-disseminated MCH information; and	Hypothesis four The use of ICT by health workers for MCH information dissemination and mothers' perception of ICT-disseminated MCH information will not significantly affect their MCH practices.	Test of Hypotheses four	
10	Examine the effect of the use of ICT by	Hypothesis five HO3: ICT use by health	Test of HO5.	Regression Analysis

	health workers and mothers' perception of disseminated information on their MCH practices	workers and Mothers' perception of ICT disseminated MCH information will no significantly affect their MCH practices.		

List of Acronyms

ICT Information and communication technology

MCH Maternal and child health

TBA Traditional birth attendant

EMR Electronic medical records

FMC Federal Medical Centre

FGD Focus group discussion

IDI In-depth interview

DVD Digital video display

mCBs Mobile community-based surveillance system

mMCHIT Mobile maternal and child health information technology

FMOH Federal Ministry of Health

NARSDA National Space Research and Development Agency

ISfTeH International Society for Telemedicine and eHealth

OpenMRS Open source electronic medical record system

ODK Open data kit

NPHCDA National Primary Healthcare Development Agency

CUG Closed user group

MMR Maternal mortality rate

MCMR Maternal and child mortality rate

MSS Midwives \service scheme

WHO World Health Organisation

SMS Short message service

USAID United States Agency for International Development

UNICEF United Nations Children Emergency Fund

UNFPA United National Population Fund

UTAUT Unified Theory of Technology Acceptance and Use